104

FEDERAL AVIATION ADMINISTRATION RESEARCH AND ACQUISITION MANAGEMENT

Y 4.SCI 2:104/9

Federal Aviation Administration Res...

HEARING

BEFORE THE

SUBCOMMITTEE ON TECHNOLOGY

OF THE

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTH CONGRESS

FIRST SESSION

MAY 16, 1995

[No. 9]

Printed for the use of the Committee on Science

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*Ranking Minority Member.
**Vice Chairman.

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FEDERAL AVIATION ADMINISTRATION RESEARCH AND ACQUISITION MANAGEMENT

TUESDAY, MAY 16, 1995

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE,
SUBCOMMITTEE ON TECHNOLOGY,
Washington, DC.

The subcommittee met, pursuant to call, at 9:38 a.m. in room 2318, Rayburn House Office Building, Hon. Constance Morella presiding.

Mrs. MORELLA. Good morning.

I am pleased to convene what will be the first of a series of hearings on the past, present, and future of the Federal Aviation Administration's research and development programs.

In today's hearing, we set the stage by reviewing the background of FAA's management, of its research, engineering, and development.

The FAA manages and operates the National Air Space System, truly a national resource. The U.S. air traffic control system represents both the success and the failure of the FAA.

Achievements in science and technology, and the dedication of over 40,000 FAA professionals, have helped make U.S. air travel the safest and the most efficient in the world.

More than a million people fly in the United States every day. In 1994, more than one-half billion passengers boarded U.S. air carriers, regional and commuter airlines enplaning 60 percent of the world's commercial air passengers. And within 20 years, our nation's air traffic control system, airlines and airports will expand to handle more than a billion passengers a year—extraordinary.

But all is not well. Today, 23 of the country's largest airports are plagued by more than 20,000 hours of delay each year. In 1990, ATC delays cost our economy an estimated $6 billion. At the current rate, these costs will increase 50 percent in the next 10 years.

Current ATC procedures do not support flight management capabilities of new aircraft, and lag significantly behind comparable telecommunications, computing, and information systems that are used in other fields.

Operational employment of modern ATC equipment and supporting systems have been chronically delayed. Equipment has been developed and delivered only to be found unsuitable by the user.

We've got to do better.

The opportunity exists for the United States to provide the world technical leadership in aviation safety and air traffic control systems. The FAA plays a pivotal role in aviation R&D, its foremost obligation to identify long-term operational requirements.

We must expand the current system's capacity, while improving its safety and reducing its inefficiencies.

But we can't meet the challenges of the 21st century with technology alone, or with the cultural, organizational, and management structures of the 1950s. We must embrace a holistic systems engineering approach, integrating the diverse skills of air crews, air traffic controllers, engineers, technicians, maintenance personnel and others, all working together to clearly define operational requirements, and how to best focus our limited fiscal resources.

It is the responsibility of this subcommittee to understand the issues associated with FAA's management of its R&D activities, and if necessary, provide the basis for broad congressional action, to implement new and challenging solutions to these perennial problems.

This is our duty and responsibility to the American people, and one which we fully intend to carry out. I'm eager to hear the testimony here today, and in the future as we continue with the hearings.

I wanted to mention that we've had some requests by some members of the subcommittee that the witnesses be sworn. And this has become sort of a policy that's been used in many subcommittees. So I wanted to ask if the witnesses would stand. And I'd like to make sure I have all of the witnesses that are going to be testifying today so we can do it at one time. Great.

[Witnesses sworn.]

[The prepared opening statement of Mrs. Morella follows:]

CHAIRWOMAN MORELLA'S OPENING REMARKS

I am pleased to convene what will be the first in a series of hearings on the past, present and future of the Federal Aviation Administration's research and development programs. Today's hearing will set the stage by reviewing the background of FAA's management of its Research, Engineering, and Development.

The FAA manages and operates the National Airspace System-truly a national resource. The U.S. Air Traffic Control (ATC) system represents both the success and failure of the FAA. Achievements in science and technology and the dedication of over 40,000 FAA professionals have helped make U.S. air travel the safest and most efficient in the world. More than a million people fly in the United States every day. In 1994, more than *one-half billion* passengers boarded U.S. air carriers, regional and commuter airlines--enplaning 60% of the world's commercial air passengers. Within 20 years, the our nation's air traffic control system, airlines and airports will expand to handle more than a billion passengers a year.

But all is not well. Today, 23 of the country's largest airports are plagued by more than 20,000 hours of delay each year. In 1990, ATC delays cost our economy an estimated $6 billion. At the current rate, these costs will increase 50% in the next 10 years. Current ATC procedures do not support flight management capabilities of new aircraft and lag significantly behind comparable telecommunications, computing and information systems used in other fields. Operational employment of modern ATC equipment and supporting systems has been chronically delayed. Equipment has been developed and delivered, only to be found unsuitable by the user. We have got to do better..

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We have requests by members of the Subcommittee that the witnesses be sworn. This is appropriate given the importance of the issues before us, and in fact is now the practice in many of our oversight committees. I would ask the witnesses appearing here today to all rise and be sworn at this time. "Do you solemnly swear that your testimony before this Subcommittee today will be truthful, complete and accurate to the best of your information and belief? If so, affirm by stating 'I do' ".

Mrs. MORELLA. Let the record report that all of the witnesses responded affirmatively.

Thank you very much.

I would now like to turn the microphone over for some opening comments, to the Chairman of the Science Committee, Robert Walker, who is here, and then turn it over to my Ranking Minority Member.

Mr. Walker.

Mr. WALKER. Thank you, Madam Chair, very much.

Greater American competitiveness and increased economic growth requires lean and effective government organizations and sensible investments in infrastructure. The Information Age allows us to do far more with far less. The advance from the vacuum tube to the computer chip resulted in a million fold improvement in productivity in only 40 years.

We expect to gain another million fold in the next 10 years. This means a trillion fold increase in productivity after the year 2000. If the Federal Government had undergone this level of renaissance, we could be providing the same service and programs for only $100,000 using only four Federal employees.

All over America, companies are finding innovative ways of doing more with less. In the last 15 years, one of our major automobile companies has transformed its organization and culture, leveraging technology to obtain new levels of quality and productivity.

Today, they produce the same number of cars with over twice the quality, using half the people.

But today the FAA is still the largest purchasers of vacuum tubes on this planet. The Advanced Automation System, once the flagship in FAA's plans to modernize the nation's air traffic control system, was started 12 years ago and estimated to cost $2.5 billion. By the contract award in 1988, the costs rose to $4.3 billion.

In December 1990, the schedule slipped 19 months. By November 1992, the system slipped another 14 months, and estimated costs had risen to $5.9 billion. In November 1993, the FAA estimated another $1.2 billion overrun.

An internal review directed by the FAA Administrator in March of 1994 stated, "If this program is permitted to continue on its present course, costs could range from $6.5 to $7.3 billion and substantial additional delays could be incurred."

Today, with over $2.3 billion sunk on the program, we still have the same old displays and still use the same old vacuum tubes. To field the scaled-back system will require another $3.6 billion, and it will still not be fully operational in this century.

This is only one example; there are others involving weather radar, runway incursion alert systems, to name a few.

Reviewing the performance of the FAA, I feel the taxpayer is at times the victim of an elaborate extortion plot by the bureaucracy. The ransom note reads as follows. "Dear Taxpayer. Give us more money and more time, or you'll never see your project again. We promise absolute final maybe almost kinda completion probably again in one year or so—we think. Thanks for your support." Signed, "Your government program manager."

Success in complex aviation systems depends on more than technological advances. We must have a clear understanding of the operational requirements, conduct mission analysis, seek alternative solutions, consider cost/benefits and risks, prior to embarking on costly, protracted R&D.

If we choose to leverage technology to meet these requirements, we must aggressively manage cost, schedule, and performance using contemporary management techniques. Our program managers must be properly trained, carefully selected, and demonstrate proven leadership. And they must be held accountable. We cannot and will not continue to do business as usual.

This is what our Republican budget initiatives are all about, ensuring that the taxpayers receive the highest value for the public resources that are invested. We are not here today on a partisan mission, but rather to bring accountability to the programs that have wandered too long in the wilderness.

I share the concerns of GAO, OTA, and others regarding FAA's acquisition management. As part of our oversight, we intend to examine these and related issues very closely. If major improvements to the air traffic control system require fundamental changes in FAA's acquisition processes, then let's get on with it.

We will not allow internal management and cultural issues to impede the modernization, expansion, safety and security of our National Airspace System as we enter the 21st Century.

I'd like to thank our Subcommittee Chair, Mrs. Morella, for initiating a very important examination of the future direction of FAA Research and Development efforts.

[The prepared opening statement of Mr. Walker follows:]

CHAIRMAN WALKER'S OPENING REMARKS

Greater American competitiveness and increased economic growth requires lean and effective government organizations and sensible investments in infrastructure. The Information Age allows us to do far more with far less. The advance from the vacuum tube to the computer chip resulted in a million fold improvement in productivity in only 40 years. We expect to gain another one million fold in the next 10 years. This means a trillion fold increase in productivity after the year 2000. If the federal government had undergone this renaissance, we could be providing the same service and programs for only $100,000 *using only four federal employees.*

All over America, companies are finding innovative ways of doing more with less. In the last 15 years, one of our major auto companies has transformed its organization and culture -- leveraging technology to obtain new levels of quality and productivity. Today, they produce the same number of cars with over twice the quality using one-half the people.

But today, the FAA is still the largest purchaser of vacuum tubes on this planet. The Advanced Automation System, once the flagship in FAA's plan to modernize the nation's Air Traffic Control (ATC) system, was started 12 years ago and estimated to cost $2.5 billion. By contract award in 1988, the costs rose to $4.3 billion. In December 1990, the schedule slipped 19 months. By November 1992, the system slipped another 14 months and estimated costs had risen to $5.9 billion. In November 1993, the FAA estimated another $1.2 billion overrun. An internal review directed by the FAA Administrator in March 1994 stated "..if this program is permitted to continue on its present course, costs could range from $6.5 to $7.3 billion and substantial additional delays could be incurred." Today, with over $2.3 billion sunk on the program, we still have the same old displays and still use the same old vacuum tubes. To field the scaled-back system will require another $3.6 billion and *it will still not be fully operational in this century.* This is only one example; there are others involving weather radar, runway incursion alert systems, to name a few..

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This is what our Republican budget initiatives are all about -- ensuring that the taxpayers receive the highest value for the public resources that are invested. We are not here today on a partisan mission, but rather to bring accountability to programs that have wandered too long in the wilderness.

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Mrs. MORELLA. Thank you, Mr. Chairman. I think your presence here indicates the importance of this subcommittee's series of hearings.

I'd like to now turn to our Ranking Minority Member, Mr. Tanner.

Mr. TANNER. Thank you, Madam Chair.

I have a very short opening statement. I too have the concern about what has happened with the FAA in this regard. However, knowing that there are 500 million or so people that fly on American airlines every year, and that that number is expected to double in the next 15, I think you also have to look at the FAA's record.

And in that regard, the record of safety, although not perfect, is, I think, commendable.

We now face, and the FAA faces, a challenge of continuing to improve its record in the safety area, and also to ensure the security of the air transportation system in the face of rapid technology change.

For example, the Office of Technology Assessment calculates that a one percent reduction in flight time due to more efficient flight paths would yield the U.S. industry savings of $250 million a year. Aircraft manufacturers estimate they could save between $800 million and $1 billion if there were uniform international standards.

And if satellite navigation and communications technologies, along with an advanced traffic management system were fully implemented, our airlines, U.S. airlines, could save almost $3.5 billion per year.

Research and development are very important tools, and the FAA will be required to do a better job, I think, in that regard.

I would like to ask the question, and I hope the panel will address it. That is, is there effective coordination and cooperation between FAA, NASA, and the DOD in aviation and aeronautic research?

I look forward to your input. There's plenty of criticism around today about everything and everybody that has anything whatsoever to do with the Federal Government. I'd like to be a voice for constructive debate and your ideas as we try to make the situation better.

Thank you.

[The prepared opening statement of Mr. Tanner follows:]

OPENING STATEMENT

HEARING ON
FEDERAL AVIATION ADMINISTRATION RESEARCH AND ACQUISITION MANAGEMENT
BY
THE HONORABLE JOHN TANNER (D-TN)
RANKING DEMOCRATIC MEMBER
SUBCOMMITTEE ON TECHNOLOGY

May 16, 1995

Aviation draws the persistent attention of policy-makers and few enterprises in the U.S. are subject to greater Federal involvement. Since the creation in 1915 of the National Advisory Committee for Aeronautics, the Federal Aviation Administration has grown to more than 50,000 employees and manages a research budget of more than three-quarters of a billion dollars.

The results of this Federal investment have been impressive. Since regular commercial air service started in the 1920s, 12,000 people have died in aircraft fatalities. This compares to the 12,000 people who die on America's highway's every four months. Today roughly 500 million people fly on American airlines each year and this number is expected to double to one billion in the next 15 years. The FAA has built a system which is unsurpassed for safety and efficiency in the world.

FAA now faces the challenge of continuing to improve its safety record while increasing the capacity and ensuring the security of the air transportation system; developing air traffic control procedures that allow for greater efficiencies for airlines; and reducing noise and other adverse environmental effects of aircraft operations in the face of rapid technological change and an increasingly globalized aviation industry. For example:

i) the Office of Technology Assessment calculates that a 1% reduction in flight time due to more efficient flight paths would yield the U.S. industry savings of $250 million per year;

ii) aircraft manufacturers estimate they could save between $800 million to $1 billion if there were uniform international standards; and

iii) if satellite navigation and communications technologies along with an advanced traffic management system were fully implemented, U.S. airlines could save $3.5 billion per year.

Research and development are important tools FAA will require to meet its future challenges. Unfortunately, serious problems have arisen in FAA's research, development, and acquisition procedures. The most prominent example is the on-going attempt to modernize the air traffic control system, which has been characterized by changing technical requirements, significant cost overruns and missed milestones.

While FAA has taken some steps to solve the problems with this particular program, the main issue is whether FAA has made the changes that will ensure that its overall investment in research and development is being used more effectively and that past problems will be averted in future programs. In an agency where the average tenure of the Administrator has barely been more than two years is it possible to institute effective reform?

I am particularly interested in the process for selection of research and development priorities. Is sufficient attention given to long-term requirements and are the users of the air transportation system adequately represented in the prioritization process? Have lasting improvements been instituted that will ensure more effective management of future projects. Also, is there effective coordination and cooperation between FAA, NASA, and DOD in aviation and aeronautic research?

Today we will hear options that have promise for increasing the return from the public investment in research and development by FAA. I encourage our witnesses to provide recommendations regarding any aspect of the policies and operations of the agency associated with research, development and testing that influence the effectiveness of FAA in reaching its mission objectives.

I commend Chairwoman Morella for convening this important hearing, and I look forward to working with her to develop an authorization bill which will guide FAA into the 21st century.

Mrs. MORELLA. Thank you, Mr. Tanner.

I'm going to call on the members of the subcommittee for any brief opening comments they may have in the order in which they appeared here in the committee room. So I'd now like to turn to Mr. Gutknecht.

Mr. GUTKNECHT. Thank you, Madam Chairman.

I don't have a prepared statement, but I do have a personal interest in this issue. As one of the members who flies home every weekend, we use the FAA and their facilities.

My first exposure as a freshman was last fall. I got a tour of the Farmington facility. I must tell you—and I won't use the word "appalled"—but I was amazed when they took me downstairs and showed me the technology that's being used down there.

In fact, it occurred to me that much of what I saw was built or developed in the late '50s. What surprised me even more was that there have been plans for, I'm not certain how many years, to modernize this system. And for one reason or another, it just doesn't seem to get done.

I would only say, Madam Chair, that I think the real goal of this subcommittee and these hearings and ultimately of this Congress, should be that we will finally get on with modernizing the FAA so that four years from now or six years from now there won't be members of the Congress sitting in these chairs asking exactly the same questions and getting exactly the same kind of answers.

I think the real goal is to really get solutions and to get on with this.

I think that sometimes here in Congress, we have a tendency to be fault-finders. Frankly, I don't think that's the role that we should play. I know that some people look for fault like there was a reward for it.

But I think we do have to ask for real honest answers and solutions to some of these questions, because I'm reminded that we won World War II in less than four years. We put a man on the moon in less time than we've been working on modernizing the FAA.

The status quo doesn't live here anymore. We're going to demand and expect real solutions to these problems.

So I would like to congratulate you, Madam Chair, for having these hearings. I hope they will be constructive. And I plan to take a very active role.

Mrs. MORELLA. Thank you. And I agree with the comments that you've made.

I'd like to now turn to Ms. Johnson.

Ms. JOHNSON. Thank you very much, Madam Chair.

Given some of the recent difficulties experienced by the Federal Aviation Administration, I'm pleased that we will have the opportunity to review the procurement and management policies of the FAA. And I commend the chairman for calling this hearing.

With Dallas/Fort Worth International Airport situated in my district, the status of the nation's air traffic control system is of vital importance to me, and I'm sure to everyone else.

I fly about 4,000 miles a week. I've not had any incidents, and I've been flying a very long time. So I know that there are a lot of things being done right.

It is my hope that the witnesses before us today will comment on the condition of the system, as well as possible improvements that they can recommend to the process. And I look forward to hearing testimony concerning the general management practices of FAA.

And finally, with my State of Texas being intimately involved in the National Aeronautics and Space Administration, I am concerned that the FAA does not adequately involve NASA in aviation research. And I look forward to hearing the recommendations of the panel regarding this issue as well.

Thank you very much.

Mrs. MORELLA. Thank you, Ms. Johnson.

You can see, members of the panel, that you're dealing with some veteran travelers here on this subcommittee, all with personal experiences.

I'd like to turn to Mr. Tiahrt.

Mr. TIAHRT. Thank you, Madam Chair.

I represent Wichita, KS, which is often known as the Air Capital of the World. So we have a vested interest, not only as a lifeline, but as quite a bit, a lot of the jobs in the Wichita area are related to aviation.

So what the FAA does is of extreme importance to my district.

I noticed on this book here, we started out with a picture of an air bus, which is manufactured outside the United States. And with Boeing in my district, I'm a little bit disappointed. I'd hoped to see a 737 when I looked down.

This AA Air system that seems to be sliding and sliding is probably about like many other projects. It started out with a great deal of exhilaration. Everyone was excited. There then came a schedule slide. Problems started to occur. They began to search for the guilty and punish the innocent.

Someday we're going to work thorough all these problems and someone who had nothing to do with the project will show up for the award.

I hope that we can get through this problem phase quickly. It seems like we've had, from what I've read, several slides. And I think that what this committee wants to do is something positive and help find out what mechanisms are in place to ensure that we don't have more schedule slides and higher costs. We're just anxious to hear the testimony.

Thank you, Madam Chair.

Mrs. MORELLA. Thank you, Mr. Tiahrt.

Ms. Lofgren?

Ms. LOFGREN. Thank you. First I'd like to thank our chairwoman for convening this hearing. I think it's certainly an important subject. As with other members of the committee, I fly, I guess, about 5,000 miles a week. So I have a personal interest as well as a public interest in it.

I, as my colleague from Texas indicated, am particularly interested in the interface between NASA and this whole area, and I look forward to hearing how that can be improved, that interface.

As with so many of my colleagues, I am concerned that we've identified some issues and problems. They are serious. But that doesn't mean that we should just blame.

We need to find solutions on how we improve the situation—that's really our role with you in partnership—so that the public can know that we've not only gotten the biggest bang for our buck, but that everything we've done helps improve safety for passengers, air travelers.

I know that is my goal, and I hear that from many members. So I look forward to the testimony, Madam Chairwoman.

Mrs. MORELLA. Thank you, Ms. Lofgren.

Mrs. Cubin, who is also a frequent flyer.

Ms. CUBIN. Thank you, Madam Chairman.

I have no formal remarks. People I think have covered this subject very well, the interest that we have here. I look forward to your testimony. Thank you for being here.

Mrs. MORELLA. Thank you.

Now, as we begin to hear from those who are going to be testifying, I'll have you do it in order. The General Accounting Office—Office of Technology Assessment will follow—Dr. Gerald Dillingham, the Associate Director for Transportation Issues, and accompanied by Mr. Matt Hampton and Mr. Robert Levin.

And then the Office of Technology Assessment, Mr. Kevin Dopart, Senior Analyst of Energy Transportation Infrastructure Program accompanied by Ms. Scott.

We have a timer here. We may not even need it, but I'm going to set it so that there is a maximum of five minutes for each of you, if you desire to use it. Please know that your entire testimony will be placed in the record. Thank you.

So we'll start now with Dr. Dillingham.

TESTIMONY OF DR. GERALD L. DILLINGHAM, ASSOCIATE DIRECTOR FOR TRANSPORTATION ISSUES, GENERAL ACCOUNTING OFFICE, ACCOMPANIED BY MATTHEW E. HAMPTON, EVALUATOR FOR AVIATION SAFETY AND SECURITY, AND ROBERT E. LEVIN, ASSISTANT DIRECTOR FOR TRANSPORTATION ISSUES

Mr. DILLINGHAM. Chairwoman Morella, Chairman Walker, and Mr. Tanner, members of the subcommittee.

We appreciate the opportunity to be here this morning to discuss FAA's research and development activities, and the relationship of those activities to the Agency's efforts to modernize the nation's air traffic control system.

We're going to focus on three areas this morning. First, the resources associated with FAA's R&D program; secondly, the Agency's progress and problems in developing and deploying systems; and FAA's recent reorganization of its R&D and acquisition programs.

The principle sources of FAA funds for R&D activities are the research, engineering, and development account, often referred to as the RED account; and the facilities and equipment account, which is referred to as the F&E account.

In 1995, the combined expenditures from these accounts was a little over $800 million, about $260 million coming from the RED account, and another $545 from the F&E account.

If the research that is conducted by NASA and DOD are added to this total, the overall resources available for aviation R&D compares very favorably to most high tech industrial sectors for expenditures on R&D.

The two accounts generally support research and development in two different areas. The R&D products from the RED program include prototypes of aviation-related systems, the basis of new procedures, and regulations and certification criteria for new equipment.

Since the passage of the Aviation Safety Research Act, an increasing amount of the budget, the RED budget, is devoted specifically to research on human factors simulation and modeling of various systems and research on aircraft structures and aviation security.

On the other hand, the majority of research-focused F&E funds are devoted to engineering, testing, and evaluation of the various elements that are going to be part of the new air traffic control system.

With regard to progress and problems in the R&D area, on the progress side, FAA research has indeed provided the basis for acquiring a variety of new air traffic control systems and safety systems. Some of these projects, such as the wind shear radar are now being deployed at airports across the nation.

There have, however, been some problems in developing and deploying systems. These problems have resulted in tremendous cost increase and lengthy delays. Our work has generally shown that a number of these problems are traceable to weaknesses in FAA's research and development program, rather than the burdensome federal procurement or federal regulations for personnel that is often argued.

Let me cite a couple of examples.

The first example, which we've heard mentioned several times this morning, is the AAS, the Advanced Automation System project, which has been recently restructured. This was the centerpiece of the modernization effort. It's the new technology to replace the outdated equipment for the air traffic controllers.

This system has ballooned from an initial estimate in 1983 of about $2.5 billion to slightly more than $6 billion today. The primary components in that system are about eight years behind schedule.

Our work suggests that these delays and cost increases were principally attributed to factors such as FAA and the contractors' over-optimistic assumptions about the complexity involved in developing such a system; specifically, the software component of the system that makes it all work.

There was also continuing changing the operational requirements for the system, and generally poor contract oversight.

Another example comes from the security research area, and deals with explosive detection in checked baggage. Here is an example where the factors were lack of early involvement by the end users, inadequate considerations about how the system would be integrated with other systems.

In this case, FAA is testing a device to detect explosives in baggage. These devices are estimated to cost about $1.7 million for an inspection station. And for a busy airport like JFK, it would require about 10 stations for one airline.

Now, although these devices are at the test stage, FAA has not determined how these devices can or will be integrated into airport operations, nor has it factored in the financial impact on the industry, or how these devices will be paid for. They plan to conduct an economic analysis after the devices have been approved for airline use.

Our last point focuses on reorganization of the R&D in acquisition functions. FAA has initiated a management approach which combines the RED and acquisition programs into one office headed by an associate administrator.

The intent of this new approach is to integrate the information from the RED program with the acquisition functions.

In this approach, the central element is to identify all the internal stakeholders for a product, bring them together at the beginning of the product as an integrated products team, a sort of cradle-to-grave project team.

FAA believes this management initiative will address many of the problems it has experienced in its R&D efforts, and strengthen the linkages between development and deployment.

In effect, the Agency hopes the new approach will solve many of the problems that it thought would be solved by its current management approach that it put in five years ago.

We would point out that there are some rather significant gaps in the program that the committee should be aware of.

For example, the external stakeholders, the ultimate end users of many of the R&D products and acquisitions, such as the airlines and airports, are not included in the integrated products team.

Also, the Agency does not plan to establish integrated product teams for aircraft safety or security research. These areas account for about a third of the RED budget.

In the final analysis, we believe that initiatives like integrated products teams, as well as some of the other initiatives that FAA is undertaking to reform itself, are necessary, but may simply not be enough. Some of these problems have been around for a long time, and have proven to be very resistant to change.

Continuous monitoring, oversight, and evaluation are critical requirements.

Chairwoman Morella, this completes our prepared statement. We'll be pleased to answer any questions you or the subcommittee may have.

[The prepared statement of Dr. Dillingham follows:]

United States General Accounting Office

GAO

Testimony

Before the Subcommittee on Technology,
Committee on Science,
House of Representatives

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AVIATION RESEARCH

Perspectives on FAA's Efforts to Develop New Technology

Statement by Gerald L. Dillingham
Associate Director, Transportation and
Telecommunications Issues
Resources, Community, and Economic
Development Division

Chairwoman Morella and Members of the Subcommittee:

We appreciate the opportunity today to discuss the Federal Aviation Administration's (FAA) research, development, and modernization initiatives. FAA conducts a wide range of research to ensure the safety, security, and efficiency of the U.S. aviation system.

Over the last few years, we have issued several reports and testified before the Congress on various aspects of FAA's research and development activities and the agency's efforts to modernize the air traffic control system.[1] Our testimony today is drawn largely from this body of work and work that this Subcommittee specifically requested on FAA's recent reorganization of the Research, Engineering, and Development (RE&D) and Acquisition programs, particularly FAA's new integrated product teams. We will provide observations on (1) trends in the nature and scope of the research activities in the RE&D program; (2) other sources of research funds that benefit FAA's efforts to develop new technology; (3) FAA's problems and progress in developing new technology and (4) FAA's recent reorganization of RE&D and Acquisition programs.

We would like to summarize our observations and then turn to a more detailed discussion of them.

-- FAA's RE&D budget has grown steadily from $150 million in fiscal year 1988 to $259 million in fiscal year 1995. In response to the 1988 Aviation Safety Research Act, FAA has increased the share of the RE&D budget devoted to human factors, simulation modeling of the air traffic control system, aircraft structures, and fire safety and decreased the share devoted to other research efforts, such as weather. It has also increased spending of RE&D funds on aviation security research and satellite navigation for air traffic control.

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[1] Related GAO products appear at the end of this testimony.

FAA's RE&D account is only one source of research and development funds that significantly benefits FAA. In addition to $259 million in fiscal year 1995 RE&D funds, FAA has allocated $545 million in its Facilities and Equipment (F&E) account for Engineering, Development, Test and Evaluation. FAA also benefits from research conducted by other federal agencies, such as the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD). At these two agencies, we identified over $645 million in research that benefits FAA.

- Research at FAA provides the basis for acquiring a variety of new air traffic control and safety technologies. Both the RE&D and F&E programs have played an integral part in the modernization effort, and some projects are now deployed at airports. However, in developing and deploying these new technologies, there have been numerous problems that have resulted in cost increases and lengthy delays. A number of these problems, such as inadequate definition of projects, a lack of awareness of the technical complexity and maturity of technologies, and a lack of end-users' involvement, are traceable to weaknesses in FAA's research and development efforts.

- FAA has embarked on a new management approach that is intended to more closely integrate the information developed in the RE&D program with acquisition functions and end-users such as controllers. For the first time, FAA's RE&D and Acquisition programs are under one office, and the agency has formed integrated product development teams. FAA believes this management initiative will address major problems with its modernization program, such as underestimating the difficulties in developing and acquiring new technologies; however, it is too early to tell if these initiatives will be successful. FAA does not plan to establish integrated product teams for aircraft safety or security efforts, which make up one-third of the RE&D budget.

BACKGROUND

The objective of FAA's RE&D program is to develop and validate the technology and knowledge required to ensure the safety, efficiency, and security of the national airspace system. FAA depends on other organizations, such as NASA and DOD, to provide basic research, while it focuses on applications. The RE&D program's focus in upgrading the national airspace system includes the development and application of high technology for automated systems, more reliable and enhanced communications, and better navigation systems. The Congress directed FAA in the Aviation Safety Research Act of 1988 to expand research and development efforts on safety and simulations of the air traffic control system.

The largest application of research and development at FAA is the modernization of the air traffic control system, which is funded from the F&E account.[2] Many of the modernization projects, such as the Advanced Automation System (AAS), have received funding under the RE&D program or have transitioned from the RE&D program into the modernization program. Most of the research for the modernization effort has been funded through the larger F&E account.

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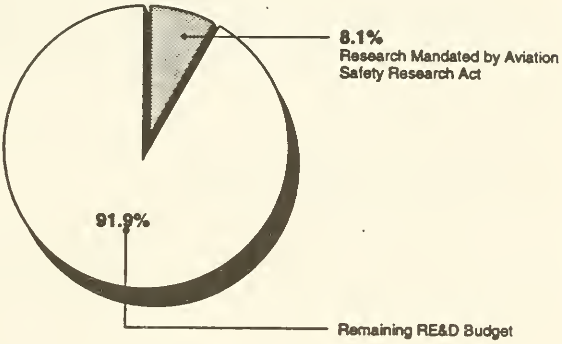
[2] In 1981, FAA launched a 10-year program to modernize the U.S. air traffic control system. The program consisted of 80 projects, funded through the F&E account, for developing and installing new equipment and systems--including radars, computers, and communications networks--to enhance the safety and efficiency of air travel and the productivity of FAA's work force. In 1990, the modernization program was redefined and expanded as the Capital Investment Plan (CIP). Currently, the CIP has 158 active projects estimated to cost $37.3 billion from 1982 through 2003. To date, FAA has completed 64 projects totaling $3.8 billion.

SCOPE AND NATURE OF RE&D BUDGET IS SHAPED BY THE AVIATION SAFETY RESEARCH ACT AND ACCIDENTS

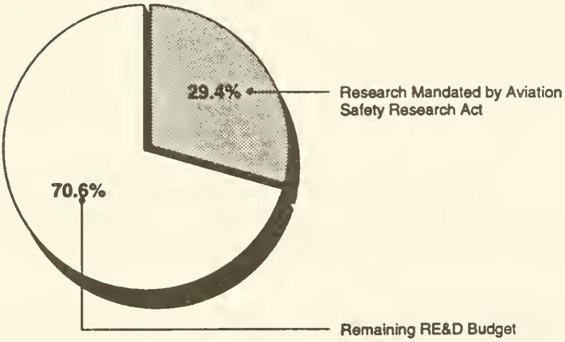
FAA's RE&D budget has grown steadily from fiscal year 1988 to fiscal year 1995 (from $150 million to $259 million). At the direction of this Subcommittee, FAA has shifted resources to research areas mandated by the Aviation Safety Research Act of 1988: human factors, simulation modeling, aircraft structures, and fire safety. Figure 1 shows that these four categories have grown from accounting for about 8 percent of the RE&D budget in fiscal 1988 to accounting for almost 30 percent of the RE&D budget in fiscal year 1995.

Figure 1: Comparison of Research Mandated by the Aviation Safety Research Act in Fiscal Years 1988 and 1995

1988



1995



In response to terrorism incidents such as the Pan Am 103 tragedy, FAA is spending more in its RE&D account on aircraft security research. Specifically, from fiscal year 1988 to fiscal year 1995, the budget share for security research grew from about 6 percent to 14 percent. In the same period, funding in the RE&D account for weather and communications, navigation, and surveillance declined in both dollars and budget share. However, some key research projects in these accounts, such as enhancing the Global Positioning System for satellite navigation, received additional funding.

CONSIDERABLE RESEARCH IS OUTSIDE OF THE RE&D PROGRAM

In addition to FAA's fiscal year 1995 RE&D budget of $259 million, over 1 billion dollars' worth of aviation research and development is conducted at FAA and other federal agencies.

First, FAA has historically conducted substantial research and development through its F&E account, but it did not delineate how much it was allocating for research activities in this account until 1993.[3] In fiscal year 1995, FAA allocated about $545 million for these activities. They include developmental work on the Voice Switching and Control System (VSCS) and the terminal and tower automation programs, which are key efforts in FAA's modernization program. FAA also funds most of its weather research from the F&E account.

Second, NASA budgeted about $1 billion for aeronautics research for fiscal year 1995, of which about $400 million is directly related to FAA's mission. For example, NASA has projects under way on air traffic control automation and on aging aircraft. Within the $400 million, NASA contributes about $30 million per year to specific joint projects with FAA on human factors and aircraft safety.

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[3] Aviation Acquisition: Further Changes Needed in FAA's Management and Budgeting Practices (GAO/RCED-91-159, July 29, 1991).

Third, FAA is benefiting from DOD's Technology Reinvestment Project (TRP). This effort, sponsored by DOD's Advanced Special Projects Agency, focuses on developing technology that has both military and commercial uses. FAA has access to research from joint government-industry projects on the detection of ice on wings and enhanced vision landing systems for aircraft. FAA estimates that over $155 million in TRP projects are under way that can or will benefit civil aviation. FAA is directly managing a $16 million TRP initiative to develop low-cost radar components to help track aircraft and weather that is co-funded by DOD and Martin Marietta. DOD also contributes about $90 million annually to FAA's research program in human factors.

ACQUISITION PROBLEMS OFTEN RELATED TO RESEARCH AND DEVELOPMENT PROBLEMS

Our work over the past several years shows that FAA has experienced significant and costly problems in moving from research to the application of technology. Some of these problems are the result of inadequate attention to issues, such as the definition of projects, technological complexity, and end-user involvement, during the research and development phase. Three projects--the Mode Select radar, the Advanced Automation System (AAS), and development of explosive detection equipment--illustrate the difficulties that FAA has experienced in developing and deploying new technology.

Consideration of Project's Purpose and Alternatives Has Been Insufficient to Ensure That Best Product Is Procured

In order to make good investment decisions, FAA needs to clearly define a project, including examining its purpose, its contributions to the agency's mission, and alternative ways of achieving the purpose. Needs assessment and alternatives analysis are functions most properly undertaken at the beginning of a research program's development of new technology. By not performing these analyses, FAA runs the risk of not choosing the most cost-effective alternative. We have found cases where FAA has not carefully considered needs and alternatives. For example, we found that FAA could have selected a more effective and less costly design for radar that would provide more accurate information on aircraft location and allow controllers and pilots to exchange data if the agency had considered a wider range of options for meeting its needs.[4] Although FAA initially considered five alternatives, combining surveillance and communications requirements had the effect of precluding all but one alternative--the Mode Select radar--from full consideration.

Underestimating Technology's Complexity and Maturity Leads to Major Delays and Cost Increases

Over the years, we have reported on the serious cost and schedule difficulties that have affected the Advanced Automation System (AAS). Conceived more than a decade ago, AAS was the centerpiece of FAA's modernization effort and the most expensive project.[5] After IBM won the design competition in 1988, design and development problems soon began to appear. A major reason for these problems was the underestimation by both FAA and IBM of the technological complexity of the system that was being developed and of the "off-the-shelf" availability of software components. Although FAA thought it was close to acquiring a new system, much more effort was required to complete research and development. Because FAA and IBM misjudged the technical effort required to complete AAS' software development, they agreed to schedules and cost estimates that were unrealistic. Total cost estimates for AAS rose from $2.5 billion in 1983 at the project's inception to $7.6 billion in 1994. The time for completion also slipped from 1994 to 2002.

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[4] Major Acquisitions: Top Management Attention Needed to Improve DOT's Acquisition Process (GAO/T-RCED-91-45, Apr. 24, 1991).

Lack of Consultation With End-Users May Make Deployment More Difficult

FAA's efforts to develop new explosive detection equipment illustrate the importance of including end-users when developing new technology. Although FAA has developed a technology to detect explosives in checked baggage, it estimates that the cost to equip one screening station is about $1.7 million. Industry officials told us that a single airline at a busy airport, such as John F. Kennedy International, could require as many as 10 systems to meet the airport's high volume of traffic. The airline industry is concerned about how this equipment will affect the efficiency of airlines' operations and about its high cost. In addition, it is not clear who will have to pay for this new equipment--the airlines, the federal government, or a combination of both. Airline representatives have said that they are skeptical about FAA's ability to develop new security technology and believe that it is critically important for FAA to test this equipment at airports.

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[5] Advanced Automation System: Implications of Problems and Recent Changes (GAO/T-RCED-94-188, Apr. 13, 1994).

According to FAA officials, the agency will face similar problems in developing and refining future initiatives for aircraft safety, fire safety, and noise abatement because the cost impact on the airline industry may be significant. The inclusion of end-users earlier in the assessment of costs and implementation of new technologies will be important in these areas.

FAA IS EMBARKING ON A NEW MANAGEMENT APPROACH TO DEVELOP NEW TECHNOLOGY

FAA's RE&D and Acquisition programs are in transition. FAA is embarking on a new management approach that, for the first time, places RE&D and acquisition under one office headed by the Associate Administrator for Research and Acquisition. FAA's new philosophy relies heavily on integrated product teams and a "cradle-to-grave" management approach whereby researchers, contract managers, maintenance personnel, and end-users are involved throughout the product's development, deployment, and life.

FAA recognizes that problems exist in the development and deployment of new technology. A March 1992 survey of FAA's research and acquisition staff found that a "stovepipe" approach existed when FAA researchers did not focus adequately on what end-users, such as controllers, need or on how the technology would be deployed and maintained. To overcome these problems and improve the development and acquisition of new technology, FAA has embraced integrated product development. Through the use of integrated product development teams, FAA hopes to resolve problems with defining requirements and ease the transition of new technology into day-to-day use, thereby speeding the introduction of the technology. FAA currently has 14 integrated product teams for, among other things, satellite navigation and aircraft/avionics.

While we are encouraged by the steps FAA is taking, it remains to be seen whether this approach will prevent past problems from recurring in developing new technology. According to FAA's top RE&D management, it may take 3 to 5 years for the new management philosophy to have an effect in the areas where it has integrated product teams. FAA has not established integrated product teams for aircraft safety and security, which account for about one-third of the RE&D budget. Without a similar mechanism for linking FAA's safety and security research with the agency's other functions as well as industry concerns about costs and implementation, important improvements could be delayed.

FAA managers believe that one of the most formidable challenges to meaningful change is FAA's culture. FAA officials describe the agency's culture as one that is averse to risk and that often pits one internal organization against another. Also, FAA officials told us that FAA's culture inhibits the effective flow of information. Such a culture is an important facet of FAA's difficulties in developing and ultimately deploying new technology, and later this year, we plan to report on FAA's culture as it relates to acquisitions.

CONCLUSIONS

FAA's research and development efforts--funded through the RE&D and F&E accounts--play an important role in developing new technology to enhance the efficiency and safety of the U.S. air traffic control system. But the agency continues to face challenges in developing new air traffic control and security technologies. Its overall program to develop new technology is in transition, and while we are encouraged by the reforms and initiatives under way at FAA, it remains to be seen if they improve the agency's ability to develop and ultimately deploy new technology.

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Chairwoman Morella, this concludes our prepared statement. We would be glad to respond to any questions that you or any Member of the Subcommittee might have.

RELATED GAO PRODUCTS

FAA Budget: Issues Related to the Fiscal Year 1996 Request (GAO/T-RCED/AIMD-95-131, Mar. 13, 1995).

Air Traffic Control: Status of FAA's Modernization Program (GAO/RCED-94-167FS, Apr. 15, 1994).

Aviation Security: Development of New Security Technology Has Not Met Expectations (GAO/RCED-94-142, May 19, 1994).

Air Traffic Control: Status of FAA's Modernization Program (GAO/RCED-93-121FS, Apr. 16, 1993).

Air Traffic Control: Justifications for Capital Investments Need Strengthening (GAO/RCED-93-55, Jan. 14, 1993).

Aviation Research: Actions to Enhance the Effectiveness of FAA's Research Activities (GAO/T-RCED-93-40, May 20, 1993).

Air Traffic Control: Improvements Needed in FAA's Management of Acquisitions (GAO/T-RCED-93-36, May 5, 1993).

Airspace System: Emerging Technologies May Offer Alternative to the Instrument Landing System (GAO/RCED-93-33, Nov. 13, 1992).

Air Traffic Control: Uncertainties and Challenges Face FAA's Advanced Automation System (GAO/T-RCED-93-30, Apr. 19, 1993).

Air Traffic Control: Advanced Automation System Problems Need to Be Addressed (GAO/T-RCED-93-15, Mar. 10, 1993).

Air Traffic Control: Advanced Automation System Still Vulnerable to Cost and Schedule Problems (GAO/RCED-92-264, Sept. 18, 1992).

Aviation Research: FAA Could Enhance Its Program to Meet Current and Future Challenges (GAO/RCED-92-180, June 3, 1992).

New Denver Airport: Safety, Construction, Capacity, and Financing Considerations (GAO/RCED-91-240, Sept. 17, 1991).

(341456)

Mrs. MORELLA. Thank you, Dr. Dillingham.

I'd now like to turn to Mr. Dopart.

TESTIMONY OF KEVIN P. DOPART, SENIOR ANALYST, ENERGY, TRANSPORTATION AND INFRASTRUCTURE PROGRAM, OFFICE OF TECHNOLOGY ASSESSMENT, ACCOMPANIED BY MS. KELLEY A. SCOTT, ANALYST

Mr. DOPART. Good morning.

My testimony today is based on OTA's study, Federal Research and Technology for Aviation. I will review OTA's findings in three areas. FAA's overall role in R&D, safety research, and air traffic control system development.

Regarding FAA's role in R&D, it is important to note that research and technology are central to the success of regulation and air traffic control, which are the two key missions of FAA.

And by many measures, FAA has been remarkably successful. Air transportation in the United States is the safest and most efficient in the world. R&D can help improve this system further.

For FAA's regulatory duties, which include safety, security, and environmental protection, the performance of the system is quite good. Additional gains will likely be incremental and relatively costly. Targeting new technologies and minimizing their costs are key R&D issues.

The situation is somewhat different for FAA's air traffic control responsibilities. Here, small advances in capacity and efficiency can mean large savings in time and money to aircraft operators and the traveling public. Such improvements are achievable if new systems can be developed and implemented on time.

Whether or not it conducts or funds the R&D, FAA must provide and ensure a strong operational perspective is included. It is here that FAA's role is most critical and in most need of strengthening.

The second area I will review today is safety research, where better information may now be more important than new technologies for future gains.

Human performance is an example of an area where scientific research is the key to greater safety. We currently have no sure solutions regardless of cost that would dramatically reduce human error as a cause of aviation accidents. We do not yet know enough about human cognition.

But this is an area where NASA, DOD, and FAA have worked together and must continue to do so.

Another type of research, system data collection and analysis, is crucial for identifying emerging safety problems. This understanding is essential for setting explicit priorities and objectives for federal R&D programs.

Thus, Congress may wish to encourage more fundamental research rather than technology development within FAA's long-term safety research programs.

The last area I will address today is air traffic control. Our system is remarkably safe, but the implementation of new technologies has been chronically delayed. Increased R&D spending and easier procurement could help speed modernization to some extent. However, OTA concludes that basic changes in the overall development process at FAA are needed to substantially cut delays in bringing new systems on line.

Air traffic R&D has been too narrow and fragmented, and has over-emphasized hardware and software development. The ATC system is not just equipment, but operational standards, practices, and procedures. To go from concept to operation most efficiently, all parts of the system must be developed concurrently.

That means research, development, and engineering of operational requirements and procedures must be strengthened and made an integral part of the air traffic system development process. However, that generally has not been done at FAA.

For example, FAA committed to the development and production of the advanced automation system, as you've heard earlier before. Fundamental operational issues were resolved, including how controllers would use the new equipment, and how existing ATC facilities would be consolidated. Thus, the AAS experienced major developmental delays.

But FAA has recognized these problems. Since OTA released its aviation report last September, ATA has introduced integrated teams for ATC development. These teams cut across the Agency's divisions, and will be involved with the project from concept to implementation.

But establishing cross-cutting teams alone is probably not enough. OTA found that intra-agency teams were difficult to manage under past organizational structures at FAA. A principle reason is that system development issues are as much cultural as they are organizational. Each segment of the aviation community—controllers, pilots, engineers, and others—has a distinct culture, with different strengths and weaknesses.

Bridging these cultural gaps is essential for effective ATC development. To accomplish this, FAA needs stronger and more stable leadership and an R&D process that is more operationally focused.

This does not necessarily require a major reorganization of FAA, or a change in its institutional status. However, neither does it preclude such actions.

In conclusion, the challenge is to ensure that changes at FAA, whether internally or externally imposed, resolve the management and cultural barriers that have plagued the Agency's R&D efforts in the past. This is especially important for ATC modernization.

It has been a challenge and a pleasure to explore these aviation questions for Congress, and we look forward to continuing discussions with this committee. Thank you, and I would be happy to answer any questions.

[The prepared statement of Dr. Dopart and the OTA Report Summary follows:]

OTA TESTIMONY

STATEMENT OF

Kevin Dopart
Senior Analyst
Energy, Transportation and Infrastructure Program

AND

Kelley Scott
Analyst
Energy, Transportation and Infrastructure Program

on

FAA Research and Technology Development

TESTIMONY BEFORE THE

Subcommittee on Technology
Committee on Science
U.S. House of Representatives
May 16, 1995

OFFICE OF TECHNOLOGY ASSESSMENT WASHINGTON DC 20510.8025

FAA RESEARCH AND TECHNOLOGY DEVELOPMENT

Introduction

Research and technology development for aviation have helped make the U.S. air transportation system, by most measures, the safest and most efficient in the world. However, there are long-standing needs to modernize and expand the U.S. airspace system, resolve aircraft safety and environmental problems, and respond to terrorism threats against air travelers. All elements of the aviation community -- public and private -- must be involved to resolve these issues. However, the role of the Federal Aviation Administration (FAA) is pivotal -- and needs to be improved.

Federal aviation R&D programs are mostly technology-driven. Technology-driven solutions often fall short of policy objectives, especially in the areas of aviation safety and air traffic control (ATC). To better anticipate new safety and efficiency challenges to the aviation system and to promptly modernize the ATC system, FAA R&D must encompass more than technology. FAA must provide and ensure that a strong operational perspective is included throughout these R&D processes whether or not it conducts or funds the R&D. For this to happen, OTA concludes that fundamental changes are needed in FAA's R&D management methods and culture.

My testimony today is based on the OTA report *Federal Research and Technology for Aviation*, which was released in September 1994. The previous Chairmen and Ranking Minority Members of the House Committee on Science, Space, and Technology and this Subcommittee asked OTA to take a comprehensive look at the federal R&D that underpins the FAA's technology and regulatory programs. In that report, OTA identifies various initiatives that Congress and federal agencies could consider in setting the national aviation R&D agenda, restructuring the management process for air traffic system R&D, and clarifying FAA's role in long-term research and in international standards development for an increasingly global aviation system.

Aviation R&D and FAA

Aviation R&D encompasses the science and technology of air transportation and systems of aircraft operations. Two broad categories of aviation R&D correspond to FAA's key missions: regulation (safety, security, and environment) and air traffic operations. Aeronautics, a fundamental field underlying aviation, addresses the design and performance of individual aircraft -- aerodynamics, structures, propulsion, and control systems.

The National Aeronautics and Space Administration (NASA) conducts both aeronautical and aviation R&D, whereas FAA's R&D focuses on aviation, where it provides and uses research results. FAA's responsibility for technology development differs for its regulatory and operational missions. FAA advances its R&D corresponding to safety, security, and environmental regulatory initiatives to the feasibility demonstration or pre-production stage. For the ATC system, however, FAA's role continues through procurement and implementation.

There is another key difference between the R&D for regulatory missions and for operation of the ATC system. The benefits from future technical initiatives in aviation safety, security, and environment will likely be incremental and increasingly difficult to implement in a system that has become extremely complex and financially constrained. On the other hand, small improvements in air traffic system capacity or efficiency are technologically feasible and would provide large savings in time and money to aircraft operators and the traveling public. For example, a 1-percent reduction in flight time due to more efficient flight paths would yield U.S. airline industry savings of approximately $250 million a year in lower direct operating costs.

Congressional Interest

The achievements of federal aviation research and technology programs have received mixed reviews. While FAA has been criticized by some for not being sufficiently proactive in uncovering safety deficiencies, the agency has a successful record of developing technological, procedural, or operational solutions once a safety problem is clearly defined. On the other hand, FAA has had a history of troubles in introducing complex technologies into the air traffic system.

Previous OTA studies have pointed to deficiencies in FAA's R&D agenda, especially the underemphasis on human factors and other long-term research issues.[1] Legislation enacted since 1988 addressed these and other concerns. The Aviation Safety Research Act of 1988,[2] introduced by this Subcommittee, called for FAA to become more future-oriented, specified human factors as part of FAA research, and created an agency advisory committee for research, engineering, and development (RE&D).[3]

Since 1988, the FAA RE&D Advisory Committee has taken an active role in reviewing FAA's R&D plans and has provided some guidance and assistance in developing and coordinating objectives that cut across the agency's missions. Cooperation and coordination with NASA and the Department of Defense (DOD) has improved, and FAA has established R&D goals and taken steps to link them to research or technological advances. However, some of the long-term research and ATC improvement objectives expressed in the 1988 Act and subsequent legislation have not yet been met, as discussed below.

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[1] U.S. Congress, Office of Technology Assessment, *Safe Skies for Tomorrow: Aviation Safety in a Competitive Environment*, OTA-SET-381 (Washington, DC: U.S. Government Printing Office, July 1988); and U.S. Congress, Office of Technology Assessment, *Technology Against Terrorism: Structuring Security*, OTA-ISC-511 (Washington, DC: U.S. Government Printing Office, January 1992).

[2] Public Law 100-591, Nov. 5, 1988.

[3] The term RE&D is used in FAA legislation, budget, and planning documents. OTA uses RE&D only when referring to specific FAA accounts, programs, or organizations that use the term in their designations. OTA uses R&D to refer generally to scientific and technological research and development conducted at FAA or elsewhere. This distinction is important, since some FAA R&D is conducted outside the RE&D program.

Regulatory Research

In the past, advances in individual technologies, such as radar and aircraft electronics, resulted in quick and noticeable improvements in aviation safety and air traffic control. Today, however, the aviation system is so safe and so complex that operational improvements often depend on more than technological advances. A greater emphasis on broad information gathering and analysis, air traffic procedure development, and scientific research is essential for continued long-term gains in aviation safety and air traffic management. Likewise, better fundamental knowledge is necessary to assess aviation's impact on the environment and lay the foundation for effective mitigation options.

Safety

Aircraft certification and inspection, navigation aids, air traffic control in busy terminal airspace, and advanced training techniques together enabled dramatic improvements in accident rates. Despite these gains, the potential for catastrophic accidents and large losses remains. OTA finds that the biggest safety problems for today's mature industry -- and probably the greatest future risks -- are in areas where we lack fundamental knowledge rather than technological expertise.

Need for continued scientific research

Basic and applied research into human performance is a critical element in the effort to enhance safety. Human error is implicated in roughly two-thirds of all accidents; this percentage has remained roughly constant despite the introduction of technologies intended to improve flightdeck operation, maintenance practices, and air traffic management. Lacking sufficient data and understanding of human cognitive processes, we currently have no clear technological or operational options that would dramatically reduce this cause of aviation accidents.

Once the nature of a problem is known, non-technological solutions may present themselves. FAA successfully seized this opportunity in the 1980s in response to the windshear hazard. Upon recognizing the metereological conditions associated with low-level windshear, FAA and industry were able to quickly put together a new training program. By increasing pilots' awareness of windshear conditions and providing them with better response procedures, windshear-related accidents decreased substantially -- well before new windshear warning devices were installed on many aircraft.

System safety data collection and analysis also important

Because safety requirements and economics are closely intertwined in today's air transportation system, a thorough understanding of the overall safety "climate" is essential to arriving at solutions that are both financially and technologically feasible. This understanding depends heavily on a strong analytical capacity. However, FAA's ability to measure aviation safety and estimate short-term changes in risk are hampered by the infrequency of and variability in major accidents -- and by the poor quality of data contained in its databases for air traffic, incident and accident, and inspection and certification.[4] Improved system data collection and analysis of risk factors could establish clearer priorities and sharpen the focus for FAA's R&D projects as well as strengthen its oversight capabilities.

Long-term research goal not met

In passing the 1988 Aviation Safety Research Act and subsequent legislation,[5] Congress intended for FAA to devote more of its R&D effort to identifying and assessing emerging problems. The Act directed FAA to set aside 15 percent of its RE&D budget for long-term research. Although fundamental research comprises a significant portion of FAA's efforts in human factors, aging aircraft, and security, FAA research to generate better information has not increased in other areas. For FAA safety R&D programs, OTA found that less than 5 percent of the effort is aimed at identifying or understanding future problems. In part, this may relate to the definition of long-term research in the 1988 Act, which did not differentiate between technology development and more fundamental research or analyses. **Congress may wish to provide FAA with a clearer mandate for long-term R&D, distinguishing between fundamental research and technology development.**

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[4] The limitations of FAA's safety databases have been cited previously by OTA, GAO and others. For most recent review on related issue, see U.S. General Accounting Office, *Aviation Safety: Data Problems Threaten FAA Strides on Safety Analysis System*, GAO/AIMID-95-27 (Washington, DC: February 1995).

[5] Public Law 101-604, Nov. 16, 1990; and Public Law 101-508, Sec. 9208, Nov. 5, 1990.

Air Traffic System Development

More than a million people fly in the United States every day and the performance of our airspace system is unparalleled around the globe. However, despite this record, current ATC procedures do not support flight capabilities of new aircraft, and ATC technologies in use lag behind comparable telecommunications, computing, and information systems used in other fields.

FAA-managed efforts to modernize the ATC system often move slowly -- to go from concept to operation can take 15 years or longer. Consequently, Congress hears perennial calls to boost FAA R&D spending and make ATC more independent of federal personnel and procurement rules. Budget autonomy and procurement reform are two cornerstones of FAA reorganization proposals in the Clinton Administration's "National Performance Review" (NPR) and "Air Traffic Control Corporation Study," as well as in the recommendations of the National Commission To Ensure a Strong and Competitive Airline Industry.[6] However, those issues are peripheral to the ATC modernization problem.

Rather than increased ATC R&D spending and easier procurement of technology, OTA's analyses indicate that basic changes in the overall development process at FAA are required for

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[6] National Performance Review, *From Red Tape To Results: Creating a Government That Works Better & Costs Less* (Washington, DC: Office of the Vice President, September 1993); U.S. Department of Transportation, *Air Traffic Control Corporation Study: Report of the Executive Oversight Committee to the Secretary of Transportation* (Washington, DC: May 1994); and National Commission To Ensure a Strong Competitive Airline Industry, *Change, Challenge, and Competition: A Report to the President and Congress* (Washington, DC: U.S. Government Printing Office, August 1993).

major improvements to the air traffic system to occur without undue cost or delay. FAA R&D spending for ATC has been more than 10 percent of FAA's total annual budget for ATC in recent years (see table 1). This figure includes development and pre-production engineering tasks funded out of the facilities and equipment (F&E) account, which is five times the amount of RE&D spending for ATC. This level of R&D investment compares favorably with figures for high-tech industries such as telecommunications and software production. Yet the results of FAA technology development have not always been successful. Regarding procurement reform, changes in federal rules would likely do little to resolve ATC operational planning and development problems or otherwise speed up significantly the acquisition of complex, safety-critical systems. While the current competitive procurement system causes delays and added expense, the resulting time lag seems to be roughly one year at most. The General Accounting Office has studied this issue and concluded that government procurement policies and regulations are not the key impediment to ATC system development by FAA.[7]

The ATC R&D process has been flawed

OTA finds that R&D management issues have been the primary impediment to ATC modernization efforts. Shortcomings in the FAA process for analyzing and establishing operational requirements and procedures have contributed greatly to chronic delays in ATC system development and implementation.

Time and again, ATC technologies reach the advanced stage of development before those who are to install or use them discover that what was developed is not what was needed. In many cases, operational problems have remained undetected until after a prototype ATC system has been completed and procurement is imminent or under way. For example, FAA committed to the development and production of the Advanced Automation System before fundamental operational issues were resolved, including how controllers would use the new equipment and how existing ATC facilities would be consolidated.

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[7] U.S. General Accounting Office, "Air Traffic Control: Observations on Proposed Corporation," testimony at hearings before the Senate Committee on Appropriations, Subcommittee on Transportation and Related Agencies, May 12, 1994.

Specifically, the problem is not with R&D for hardware and software per se, but with R&D for air traffic operational procedures and requirements. The combination of rigorous safety requirements, continuous operations, large scale, and complexity makes the ATC system different from most other technological systems. The ATC system is not just equipment, but operating standards and procedures. Both parts of the system must be developed in concert. To accomplish this, **research, development, and engineering for operational requirements and procedures must be strengthened and made into an integral part of FAA's ATC system development process.** OTA concludes that three key steps are needed (see box 1):

- closely involve experienced operational personnel in the development process,
- develop operational procedures early enough to affect the technology development process, and
- use dynamic simulations as "operational development" tools as well as "technology development" ones.

FAA's RE&D Advisory Committee identified some of these issues in 1991.[8] Until recently, none of these steps was a standard part of the R&D process at FAA.

Bridging cultural gaps

FAA has also recognized some of the operational development issues mentioned above and is trying to resolve them. Almost all agency operating units interviewed by OTA reported improved relations with FAA's R&D division, and the general feeling is that technology R&D is more targeted than in the past to their needs. However, previous attempts to incorporate operational expertise into its

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[8] FAA Research, Engineering and Development Advisory Committee, R&D Plan Review Panel, *Review of the FAA Research, Engineering and Development Program* (Washington, DC: November 1991), pp. 32-33.

ATC technology development efforts have not had wide success, in part because FAA still lacks the institutional incentives to ensure consistent operational guidance for ATC system development and implementation.

A major factor is that technology development has been the dominant tenet of FAA system development programs. As a result, technological improvements, rather than operational advances, have become the focus of many projects. Air traffic controllers, equipment technicians, pilots, engineers, and program managers are vital to ATC system development as well as its operation. However, communication and coordination among FAA's operational sections and technology developers have been impeded by long-standing cultural differences among these groups, particularly regarding the priorities, knowledge, management methods, and perspectives for ATC system development.[9]

Furthermore, operational experts' scrutiny of development projects can be threatening, and is typically deferred as long as possible. For example, the primary justification for the proposed Microwave Landing System (MLS) was changed or superseded by other technologies[10] at least three times in the project's history – yet the project stayed alive for three decades.

One former FAA Administrator believes that the most critical challenge is to get the "Air Traffic, Flight Standards, and R&D parts of the Agency to work as a team. It has never happened."[11] Whether pilots, controllers, and other operators are consulted early or late in the process, their assessments will have major impacts on new systems. For example, safety and efficiency are the primary purposes for ATC, but rarely is there agreement on what levels of safety and efficiency are acceptable or how they can be measured. Unresolved concerns about new risks slow the ATC development process. Consequently, it is important to tackle safety concerns as early and openly as possible to minimize the costs of delayed operating efficiency benefits.

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[9] The problem has not been confined to the ATC world. In the late 1980s, coordination was weak between FAA's aviation security regulation section and the agency's security R&D branch at the Technical Center. See U.S. Congress, Office of Technology Assessment, *Technology Against Terrorism: Structuring Security,* OTA-ISC-511 (Washington, DC: U.S. Government Printing Office, January 1992) for more information.

[10] New capabilities that could serve some MLS missions include better instrument landing system performance, potential for curved approaches using onboard flight management systems, and highly accurate satellite navigation.

[11] John McLucas, personal communication, June 29, 1994.

User input and operational expertise

Acquiring user input is an essential step in identifying operational requirements. For the development of the new 777 aircraft, Boeing used this *concurrent engineering* approach and met with success. Likewise, FAA increasingly welcomes industry into its fold. In recent years, FAA established operational implementation teams for satellite navigation and for communications and surveillance. Sponsored by the Flight Standards and Air Traffic Control organizations within FAA, the teams work closely with industry and representatives of the various FAA organizations to improve the process for developing performance standards and operational requirements.

FAA has recently taken additional steps to enhance the role of operational perspectives in its ATC R&D process. FAA is attempting to bring about "considerable change in cultural norms and organizational processes" through establishing a number of Integrated Product Teams. In April 1995, FAA Associate Administrators signed a memorandum of agreement to improve coordination among FAA functional divisions (e.g., Research and Acquisition, Air Traffic Services, Regulation and Certification, and Airports) and ATC system users. The larger goal is sustaining a customer-driven approach to system development.

It remains to be seen whether these teams will have a long-term effect on the FAA R&D process. OTA found that intra-agency teams were valuable, but difficult to manage under past organizational structures at FAA. Such crosscutting teams face a dilemma involving the power of each member. A strong voice for each is essential, but too much influence on the decision process leads to problems. The boundaries of authority and the levels of required management review must be clearly identified at the outset.

Options for Congress

OTA concludes that key criteria necessary for more effective ATC system development include stable leadership, multidisciplinary development teams that cross organizational and public-private boundaries, and a commitment and understanding that ATC system development must be more operationally driven than technology driven. This does not necessarily require a major reorganization of FAA or a change in its institutional status. However, neither does it preclude such actions. In the current internal structure of FAA, three organizations -- Air Traffic, Regulation and Certification, and Research and Acquisitions -- have important technical responsibilities for ATC system development. However, no one below the Administrator has had the authority or the mandate to effectively bridge these FAA organizations. Moreover, long-term system development requires long-term leadership, but the average tenure of an FAA Administrator is far shorter than the development cycle of most ATC systems.

One option for Congress is to create a new, fixed-term position at the Deputy Administrator level with responsibilities for system development oversight and coordination within FAA. This person would be provided with a clear mandate to integrate operational and technological development processes, would have the authority to form teams from across the agency, and would maintain a core staff to administer teams. In essence, he or she would be responsible for the actual direction of entire projects and would have sufficient status to make things work. OTA believes it is necessary that these functions be performed regardless of whether Congress considers establishing a fixed term for the

FAA Administrator.[12] Many aviation issues and immediate crises other than system development vie for the Administrator's attention; a fixed-term Administrator, like the Administrator in the present FAA, would need subordinate executives to manage and oversee ATC development.

Conclusion

The challenge for Congress is to ensure that organizational changes at FAA resolve the internal management and coordination impediments in the R&D process, especially for the ATC system. In the course of its research, OTA heard little confidence expressed in FAA's ability to plan for and introduce new ATC systems effectively without some change in institutional structures and incentives. FAA has claimed, and then failed, to have overcome system development and acquisition hurdles a number of times during the past decade. **As long as technology development remains the dominant culture in FAA system development programs, however, implementation problems will persist.**

It has been a challenge and a pleasure to explore aviation research and development questions for Congress and we look forward to working with this Committee on these and other technological issues in the future.

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[12] This option has been proposed by a number of studies, including U.S. Congress, Office of Technology Assessment, *Safe Skies for Tomorrow: Aviation Safety in a Competitive Environment*, OTA-SET-381 (Washington, DC: U.S. Government Printing Office, July 1988); and Aviation Safety Commission, *Volume I: Final Report and Recommendations* (Washington, DC: April 1988).

TABLE 1: FAA Spending on ATC R&D

Accounts and calculations	FY 1993 actual ($ millions)	FY 1994 request ($ millions)
RE&D account		
(1) ATC portion	$ 98.8	$ 112.6
F&E account		
(2) EDT&E	555.2	549.2
(3) DT&E	16.0	10.6
(4) Non-ATC procurement	59.6	127.2
(5) Total	2,465.0	2,524.0
Operations account		
(6) ATC programs	3,480.9	3,522.9
(7) Overhead (ATC portion)[a]	423.6	415.7
(8) **Total ATC-related R&D spending** = (1)+(2)+(3)	670.0	672.4
(9) **Total FAA spending on ATC** = (1)+(2)+(3)+(6)+(7)	6,408.7	6,448.0
FAA ATC-related R&D spending as a percentage of total FAA spending on ATC = (8)/(9)	**10.5%**	**10.4%**

[a] Office of Technology Assessment estimate Overhead spending was prorated according to the ratio of ATC programs to non-ATC programs in the operations account.

KEY: DT&E = development, test, and evaluation; EDT&E = engineering, development, test, and evaluation; F&E = facilities and equipment; RE&D = research, engineering, and development.

SOURCES: Office of Technology Assessment, 1994, based on Budget of the United States Government, Fiscal Year 1994, Federal Aviation Administration budget documents; National Aeronautics and Space Administration.

BOX 1: Possible Steps for More Effective ATC System Development

- **Involve suitably experienced operational personnel in the planning and prototype development process.** Effective system development requires a balance of operational and technical views, and neither should dominate. The planning, analyses, and experience of operating organizations, at the Federal Aviation Administration and across the aviation community, are critical to properly matching technological options to safety and operational initiatives. "Too little, too late" has usually described the involvement of operational experts in ATC development.

- **Conduct operational analyses and develop operational procedures for new system concepts early enough to affect the technology development process.** Proposed operational procedures must be developed in sufficient detail that controllers, pilots, and other groups can understand and draw conclusions on the safety and operational implications. Moreover, the operational and technical components of each ATC system must be developed concurrently, and must include frequent feedback from the aviation community.

- **Use dynamic ATC simulations as "operational development" as well as "technology development" tools.** Dynamic ATC simulation resources, capable of including real controllers and pilots, are essential to rapidly develop and test new ATC system concepts and procedures. Operational issues such as human-machine interface and airspace configurations can be studied before the technology is fully mature. Proposed operational procedures and technological concepts can be criticized constructively with dynamic simulations, provided that both operational and technical experts are closely involved in the process. When used in the past, dynamic simulations have focused primarily on validating and fine-tuning technological concepts.

SOURCE: Office of Technology Assessment, 1994.

OFFICE OF TECHNOLOGY ASSESSMENT U.S. CONGRESS SEPTEMBER 1994

OTA REPORT SUMMARY

Federal Research and Technology for Aviation

Research and technology development for aviation has helped make the U.S. air transportation system the safest and most efficient in the world. But the system could be improved further (see table 1). During the past decade, considerable congressional attention has been given to the need to modernize and expand the U.S. airspace system, address aircraft safety and environmental issues, and respond to terrorism threats against air travelers. To continue to serve the national aviation needs well in the next decades, changes will be required in research and development (R&D) processes and organizations that support federal regulation and operation of the aviation system.

The Office of Technology Assessment report **Federal Research and Technology for Aviation** identifies various initiatives that Congress and federal agencies could consider in setting the national aviation R&D agenda, restructuring the management process for air traffic system R&D, and clarifying the Federal Aviation Administration's (FAA) role in long-term research and in international standards development for an increasingly global aviation system.

OTA concludes that more effective approaches to priority setting and analysis need to be developed, and the means found to ensure that all parties who will be part of solving a problem are considered in formulating the solution. This is especially important for air traffic system development, where technology decisions have not always meshed with operational requirements.

Moreover, this country and much of the world are relying on post-World War II institutions for aviation that have not been able to transform themselves as needed to accommodate changes in technology, a global economy, and more modern forms of management. New technologies for air traffic system infrastructure will require new institutional relationships among national airspace authorities and also between public and private providers of aviation communications and navigation systems.

AIR TRAFFIC MODERNIZATION

Although U.S. air traffic control (ATC) is far superior to most systems around the world, it still uses equipment and procedures that fall short of what is technologically feasible. Small, achievable advances in system capacity and efficiency could mean large annual savings—hundreds of millions of dollars or more in the United States alone—to aircraft operators and the traveling public.

Air Traffic System Modernization

WHAT IS AVIATION R&D?

Aviation R&D encompasses the science and technology of air transportation and systems of aircraft operations. Two broad categories of aviation R&D correspond to FAA's key missions: regulatory (safety, security, and environment) and operational (air traffic control—ATC). Aeronautics, a fundamental field underlying aviation, addresses the design and performance of individual aircraft—aerodynamics, structures, propulsion, and control systems.

NASA conducts both aeronautical and aviation R&D; FAA's R&D focuses on aviation, where it provides and uses research results. FAA's responsibility for technology development differs for its regulatory and operational missions. FAA advances its R&D corresponding to safety, security, and environmental regulatory initiatives to the feasibility demonstration or pre-production stage. For the ATC system, however, FAA's role continues through procurement and implementation.

However, ATC system development and implementation are chronically delayed; an FAA -managed ATC project can take 15 years or longer to go from concept to operation.

OTA's analyses indicate that, while increased spending and easier procurement for technology could help speed ATC modernization, major improvements to the air traffic system will require fundamental changes in the overall ATC R&D process at FAA . The combination of rigorous safety requirements, continuous operations, large scale, and complexity makes the ATC system different from most other technological systems. The ATC system is not just equipment, but operating standards and procedures—the rules of the game. Both parts of the system must be developed in concert. However, that generally has not been the case. For example, FAA committed to the development and production of the Advanced Automation System before fundamental operational issues were resolved, including how controllers would use the new equipment and how existing ATC facilities would be consolidated. Inadequate understanding of operational and procedural issues, rather than insufficient technological expertise, has been the primary impediment to modernization efforts.

If the longstanding problems in ATC modernization are to be resolved, research, development, and engineering for operational requirements and procedures must be strengthened and made into an integral part of FAA 's ATC system development process. Three key steps are needed:

- closely involve suitably experienced operational personnel in the planning and prototype development process,
- conduct operational analyses and develop operational procedures for new system concepts early enough to affect the technology development process, and
- use dynamic simulations as "operational development" tools as well as "technology development" ones.

Figure 1 presents one model for integrated operational and technological development of ATC systems.

NEW TECHNOLOGIES AND INSTITUTIONAL CHANGE

As digital communications networks and satellite systems become the primary air navigation infrastructure for the United States, FAA priorities and responsibilities for system development, operation, and oversight will need to change. This will be so whether or not a

Table 1. Summary of Aviation Research and Development Issues

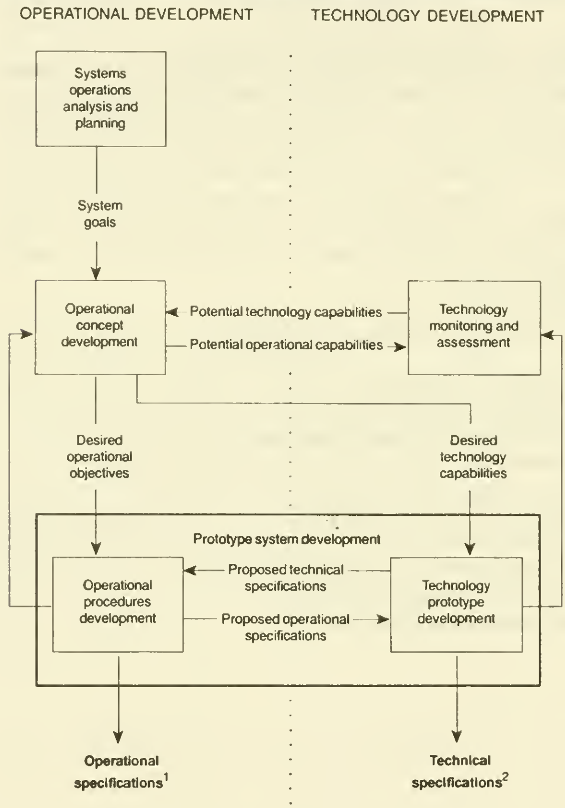
Issue	Potential Improvements
Airspace efficiency	*Increased capacity and less delay, without diminished safety, by:* ■ Enhancing communications, navigation, and surveillance technologies and procedures to permit closer spacing between aircraft and increased aircraft arrival and departure rates at airports. ■ Augmenting airport surface traffic management capabilities, especially in low-visibility conditions. ■ Improving the reliability and accuracy of weather forecasts.
Safety	*Fewer and less severe accidents by:* ■ Improving the reliability of engines, avionics, and other aircraft systems. ■ Enhancing aircraft crew and controller awareness of aircraft situation in all conditions. ■ Reducing personnel fatigue and stress. ■ Reducing fire threat. ■ Enabling better crew communication and coordination. ■ Enhancing structural airworthiness and crashworthiness.
Security	*Threat deterrence and mitigation by:* ■ Enhancing explosives and weapons detection capabilities. ■ Increasing aircraft resilience to explosives. ■ Improving passenger and cargo screening methods and airport security systems. ■ Ensuring secure air traffic control systems design and operation.
Environment	*Less environmental impact from aviation by:* ■ Reducing aircraft noise emissions in order to lower or maintain community noise levels as operations increase. ■ Minimizing engine emissions and increased fuel efficiency. ■ Improving management of existing deicing and firefighting compounds and introducing new, more environmentally benign materials. ■ Improving aircraft cabin air quality.

SOURCE: Office of Technology Assessment, 1994 new ATC organization is created (as has been proposed by the Clinton Administration). New communications, navigation, and surveillance (CNS) systems make possible fundamental changes in how and where ATC services are provided, and raise difficult policy questions regarding infrastructure sovereignty and security. With these networks, top-notch air traffic services—equal to or better than the capabilities of the current U.S. domestic airspace system—could become practical anywhere in the world.

However, it is not financially or politically feasible for a single national agency to independently develop, build, and operate all of the elements comprising such a future ATC system.

While FAA's current efforts to implement such CNS systems for U.S. operations could potentially form the basis for an efficient international system, these new technologies provide the opportunity for private or other nonfederal organizations to own and operate some communications satellites, digital networks, and other key elements of the CNS infrastructure.

Figure 1. A Model for Concurrent Development of ATC Systems


OPERATIONAL DEVELOPMENT
TECHNOLOGY DEVELOPMENT
Systems operations analysis and planning
System goals
Operational concept development
Potential technology capabilities
Potential operational capabilities
Technology monitoring and assessment
Desired operational objectives
Desired technology capabilities
Prototype system development
Operational procedures development
Proposed technical specifications
Proposed operational specifications
Technology prototype development
Operational specifications[1]
Technical specifications[2]

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[1] For Federal Aviation Administration orders and regulations, ATC handbook and other guidance

[2] For hardware and software

SOURCE Office of Technology Assessment, 1994

Research for Aviation Safety and Environmental Protection

New operational and economic opportunities offered by these technologies must be balanced against possible reliability and security risks, and international cooperation and coordination for air traffic system development and operation will need to be strengthened substantially. FAA's research, analysis, and technology development efforts will need to adjust, and possibly expand, to apply and integrate these new capabilities into the airspace system and for FAA to certify and regulate their operation. However, the agency's ultimate responsibility for safety need not and most likely should not change.

RESEARCH FOR AVIATION SAFETY AND ENVIRONMENTAL PROTECTION

Safety requirements, environmental protection, and economics are closely intertwined for aviation. FAA and the aviation community have endeavored to make safety preeminent; the U.S. record attests to their success. However, disagreement is intense on the value and economic consequences of possible technological and procedural options and what new operating challenges will emerge in the future. Benefits from future technical initiatives in aviation safety, security, and environment will be incremental and increasingly difficult to implement in an ever more complex and financially constrained system.

As regulator and ATC operator, FAA has ties to all segments of the aviation community. FAA's foremost obligation for aviation research and technology is to identify the long-term operational requirements for the aviation system. In carrying out this responsibility, it is important for FAA to work with other federal agencies conducting research to ensure that the specific needs of aviation are addressed within other research programs.

SAFETY

A diverse technology base remains essential for future aviation safety gains. FAA, the National Aeronautics and Space Administration (NASA), and the Department of Defense are investigating numerous aircraft technologies that promise new levels of safety performance—cabin water spray, fire-resistant materials, explosive-resistant aircraft systems, and advanced sensors, to name a few. However, the biggest safety problems today and the greatest risks in the future will likely come from areas where we lack fundamental knowledge rather than technological expertise. Human performance is the leading example of a field where basic and applied research is the key to better safety.

Better data collection and analyses of the aviation system could help in setting priorities and objectives for federal aviation R&D and ensuring that new technological systems bring the greatest benefits. The aviation system relies on a range of research efforts—from collecting safety inspection data to scientific investigations. For both present and future systems, a clear understanding of the problems is essential; it is here that FAA's role is most critical and in most need of strengthening.

AVIATION AND THE ENVIRONMENT

Environmental challenges are expected to be a key constraint on aviation industry growth during the next decade. As with safety issues, effective response to environmental problems requires adequate data and analytic capability to understand the extent of problems and optimize mitigation options. For aviation environmental policy, unlike aviation security and safety, no one federal agency has the leadership role.

FAA has responsibility for setting aircraft noise standards and for assisting communities in assessing and abating airport noise. NASA has been the lead agency for aviation noise research. With FAA and industry support, NASA has incorporated challenging noise reduction goals into its newly launched research initiative on subsonic aeronautical technology.

Beyond the issue of aircraft noise, there has been no clear federal policy guidance or support for aviation environmental research. The unified regulatory-R&D approach enjoyed by the noise effort, in which FAA works closely with NASA to plan R&D and shape technical requirements, has rarely been applied to other environmental concerns such as air quality. The U.S. Environmental Protection Agency has broad regulatory authority over these issues but has devoted few of its analytic or research resources to aviation-specific problems.

When addressing broad issues such as climate change or air and water quality, a comprehensive understanding of aviation's impact on the environment, particularly relative to other sources of pollution, is needed. OTA finds such data are not always readily available, and the lack of an explicit mandate to address non-noise related issues, combined with FAA's small environmental R&D budget, limits that agency's ability to move quickly on emerging issues. There are few staff to devote to environmental issues other than noise, and FAA must rely on NASA and other federal agencies to perform scientific work and technology development.

Furthermore, a comprehensive R&D agenda has not been established and no mechanism yet exists for ensuring and integrating input from the appropriate agencies. The lack of an integrated U.S. approach to defining environmental risks from aviation and the commensurate level of regulatory and R&D attention are hampering a timely, effective response to environmental challenges that confront the industry. This piecemeal approach may undermine U.S. leadership in setting aviation environmental standards and result in environmental policy decisions that inadequately consider the aviation safety and performance implications of new technology or operating mandates. At a minimum, the sharing of existing data and impact assessments among federal agencies is needed, along with cooperative evaluation of emerging issues.

Policy Options

Table 2. Possible Policy Goals, Strategies, and Options

Resolve flaws in the Air Traffic Control R&D process through more emphasis on the development of operational requirements and procedures.

Strategy: Ensure that stable leadership, strong operational focus, and multidisciplinary development teams become integral elements of any U.S. ATC organization.

- If no major FAA restructuring is desired, create new, fixed-term position at the Deputy Administrator level with responsibility for both operational and technology sections of FAA.
- If major institutional changes are desired, such as making FAA or its ATC sections an independent agency or corporation, require a stronger operational focus than presently exists.

Strategy: Revise federal budget and acquisition criteria to explicitly and adequately address the development of operational requirements and procedures.

Accelerate international implementation of new communications, navigation, and surveillance (CNS) infrastructure for air navigation and traffic management.

Strategy: Pursue more collaboration between federal agencies and the private sector for CNS development and implementation while ensuring adequate FAA oversight.

Strategy: Promote opportunities to strengthen international efforts to develop and implement standards and equipment.

- Bolster FAA technical support for International Civil Aviation Organization (ICAO) panels.
- Negotiate, outside of ICAO, bilateral or multilateral agreements for technical standards.
- Develop and support internationally acceptable institutions to control and operate these systems.

Provide better information and more effective guidance for federal aviation regulatory and technology decisions.

Strategy: Ensure the early and continuing advice of operational and technical experts in federal aviation research, regulatory, and technology decisions.

Strategy: Better anticipate aviation safety, security, environmental, and air traffic system challenges.

- Strengthen data collection and analyses in aviation operational areas.
- Encourage more fundamental research and analysis to identify and assess emerging problems within FAA's long-term research responsibilities.
- Establish a comprehensive environmental research agenda at federal agencies for subsonic aviation.
- Bolster FAA environmental programs to allow additional technical specialists in the areas of emissions and climate.

Strategy: Further improve interagency coordination and cooperation for aviation research and technology.

- Clarify FAA's role in shaping the federal research agenda for aviation.
- Designate explicit federal agency responsibilities for domestic and international aviation environmental issues and explore means of closer coordination between the Environmental Protection Agency and FAA.
- Make interagency and cross-disciplinary research a goal for certain FAA research programs and facilities, and support temporary interagency transfers of staff.

NOTE All strategies, and most of the options, are not mutually exclusive

SOURCE: Office of Technology Assessment, 1994

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Mrs. MORELLA. Right on time. What an efficient response we've had from both of you.

Now, if there are no other comments from those who have accompanied you, I'll start the line of questioning.

Our chairman has left. So I guess I'll start off with GAO since, Dr. Dillingham, you were the first to testify this morning.

I'd like to ask you, what were the technical and managerial factors that resulted in cost and schedule problems with the AAS?

Mr. DILLINGHAM. Chairwoman Morella, I think probably the biggest contributor was a sort of over-ambitious, or thinking that something could be done in a relatively short period of time, thinking that much of the software that would be needed to operate this very complex system and combine the existing ATC system was going to be something that could happen overnight, or at least not on the schedule that they had proposed.

And I guess, early on in the contract with IBM-Hughes, there was very little oversight of what was going on with the contract. So that a lot of money passed, and a lot of time passed before FAA realized that we were not going to be able to get the system that we needed.

So it's contract management. It's under-estimating how complex the systems were going to be to in fact bring on line.

Mrs. MORELLA. Do you think that that has changed now, that they're on the right road? I know that changes with the IBM contract——

Mr. DILLINGHAM. Well, what has happened now is that there is a much less ambitious plan in place. The contract has been changed. It is now moving over to something that is more manageable. It has definitely been scaled back. I think Mr. Levin can probably speak a little bit more to that.

Mr. LEVIN. Yes. One of the reasons the FAA went to the display system replacement is to scale back the requirements and make it easier to produce an en route automation system.

Also, they broke up AAS into three parts: a terminal piece, a tower piece, and an en route piece, to coincide with the air space that FAA controls. So hopefully, that will make it more manageable.

In addition, they've set up means of increasing oversight. I see FAA emphasizing performance metrics. For the many years, the GAO has been overseeing AAS, we've continually pointed out that FAA really didn't know what it was getting, as the system was being developed.

When do you know that IBM was producing a system that was going to work? And the answer that we always got back was, "Well, we're going to test it."

Well, somewhere between starting the project and testing the first system, there has to be some sense of progress. And that was kind of missing there.

Mrs. MORELLA. It always surprised me that they were so into this. And it just seemed to be exacerbated by continuing on the wrong road without the kind of oversight that was necessary, that you point out.

You mentioned that understating the technical complexities of modern system development is a causal factor in FAA modernization problems. Therefore, how would you characterize FAA's technical competence as it would compare with its industry counterparts, comparatively?

Mr. DILLINGHAM. Chairwoman, we have not looked directly at that question. However, we have reviewed studies that have been done by several other organizations, the Volpe National Transportation Center, the Center for Naval Analysis, the Lincoln Lab. All of them have come to the conclusion that FAA has neither the quantity nor the quality of person that are needed to oversee this kind of contract.

Though we haven't looked directly at the people and their qualifications in AAS in that area, we did look at another area that has a lot of similarities. We looked at the certification force for inspecting airlines.

The last example we looked at is the 777, the new airline coming on from Boeing. And FAA didn't have the technical competence among its own staff to make that certification with some of the advanced avionics. They in fact had to depend on the contractor to make many of the certification decisions about that aircraft.

Mrs. MORELLA. So there's really a kind of lack of close scrutiny to the qualifications of personnel. You're down to the people factor. Is that correct?

Mr. DILLINGHAM. Yes, that's correct.

Mrs. MORELLA. Do you think they're now improving in that regard, Mr. Levin?

Mr. LEVIN. No. I think there's a real problem.

In fact, a very recent FAA study on support contracts, if I can quote from it. "The number of FAA employees with relevant technical skills and abilities is rapidly decreasing."

The study went on to point out that, for such major programs as data link, voice switching, automation programs like AAS, GPS, FAA is sorely lacking in the technical capabilities, and relies heavily on support contractors. The FAA engineers basically become contract managers more than technical leaders of these programs.

I would suggest that the committee might want to follow up with FAA on the results of this study.

Mrs. MORELLA. I was just going to ask, do you want to comment on, how do you shake them up?

Mr. HAMPTON. If I might add, you've seen over the last few a years a transition from where FAA has, instead of doing the research themselves, contracts more and more out. About 70 percent of FAA's research budget now is contracted out, and the majority of that is also contracted out in the F&E account.

And this requires a different, I think, set of skill mix. It requires some technical expertise as well as management expertise. To be able to manage that type of research and those kind of efforts requires a certain skill mix. And I'm not sure FAA has that today.

Mrs. MORELLA. Something we need to look at.

I'd like to ask Mr. Dopart just one question so I can then get on. And we'll have a second round of questioning after that.

When you talk about technology, this is the technology subcommittee, what do you see as the difference between that term "technology" versus "operationally driven R&D"? Operationally driven R&D—is that clear?

Mr. DOPART. Certainly I can answer that question.

In the context of our report, when we used "technology," we were referring to equipment, whether it be software or hardware. When you view the whole air traffic control as a system, there are other elements that can be treated from a research standpoint, including the air space system, the procedures, the airways, the rules of the road, so to speak.

And those issues, the operational concept and procedures, can actually be developed in quite detail early on at the point where you reach a prototype, or even before. From the controller's standpoint, it's knowing how they're going to work in the system, regardless of what's inside that black box. Those issues can be addressed, analyzed, through the use of dynamic simulations, for example, early in the process.

So these safety concerns and other questions can be addressed up front, instead of causing costly delays later on.

Mrs. MORELLA. Do you want to make a brief comment about the ATC system development in the implementation? Would you like to comment on why it's been so delayed?

Mr. DOPART. I would say the simple answer to that is, the engineers, the controllers, and the users of the system—the pilots, the industry—have not worked well together in the past.

Mrs. MORELLA. Well, we'll have further discussion on that. But now let me turn to a ranking member, Mr. Tanner.

Mr. TANNER. Thank you, Madam Chairwoman.

I've just got a couple of questions, and it relates back to what I said in my opening statement with respect to the coordination between the various agencies.

Dr. Dillingham, on page 7 of your testimony, you relate that the FAA is benefiting from DOD's technology reinvestment project, and that is has access to research from this joint government/industry project on the detection of ice on wings, and enhanced vision landing, and so on and so forth.

What, from your opinion and investigation of this entire matter, what will the effect be on that part of FAA's efforts if the budget document has been presented which zeroes out the technology reinvestment program is enacted?

Mr. DILLINGHAM. If the program is zeroed out as is proposed, I think that would probably just eliminate that aspect of the cooperation. But FAA and NASA are cooperating in a number of areas. And in fact, that cooperation is improving in some ways.

At one point, we were concerned about a not-invented-here syndrome, where neither agency really wanted to take something from somebody else. But that sort of problem has been resolved pretty much.

We also were concerned that many of the projects with NASA and DOD were just not a top-down sort of thing. They were sort of from the middle. Both of those areas are now being addressed differently.

DOD has also many other resources that FAA is tapping into at this point.

Mr. TANNER. Should DOD get out of this business with the FAA, in your opinion?

Mr. DILLINGHAM. I think not. I think, as you have alluded to, we are in a period of having to do more with less. And if the agencies can work together, if they can not duplicate each other's research, then I think that's a positive.

Mr. HAMPTON. I'd just like to clarify. The $155 million we note in our testimony is money that was previously appropriated. So that $155 million will not be taken away. The future projects in the TRP program that could have totaled maybe, you know, $400 million, $300 million that could have benefitted FAA in the future, if budget cuts occur that will not happen.

But the $155 million will benefit FAA until it's expended.

Mr. TANNER. I understand that. But the ice on the wings and so forth, you would say that is important to the safety of the traveling public, would you not?

Mr. DILLINGHAM. Definitely.

Mr. HAMPTON. Definitely.

Mr. TANNER. And then, Mr. Dopart, you indicate in your testimony that the problem that FAA has with respect to the implementation of technology is really a matter of management, is it not; that the operations of FAA have not been paid enough attention to with respect to the technology coming on line and how you utilize that technology?

I'm on the Armed Services Committee, and we say that technology won't win a war. Soldiers and sailors and airmen have to win a war. But you can't win one without technology.

And I guess there's an analogy here. No matter what technology comes on board, it still goes back to how it is implemented, and how the people that actually do the hands-on work are trained in order to maximize it and utilize this new equipment; is that correct?

Mr. DOPART. Yes, sir. The people are the most critical element of this system. And they're important to you, not only operating it and understanding how it works, but being involved in making the decisions early on in the development process.

Mr. TANNER. Comment, if you would, on how we can assist the FAA in making sure we maximize the effort in terms of operational training of people.

Mr. DOPART. I would say the most important issue at FAA to ensure that the key training and other development issues are taken care of is in some way to ensure some stable leadership and accountability.

The question I guess I would have to pose back is, who will this committee hold accountable?

Mr. TANNER. You've indicated also that we need to create, not only, as Congress has, the administrator having a fixed term, but you want, you recommend a fixed term at the deputy administrator level.

Mr. DOPART. You're correct. We listed those as various options—okay—it lays out options for Congress to choose among.

We felt it was important that there be someone with a position of authority that could coordinate among the three key divisions at FAA that are involved in some aspects of air traffic control development, the research and acquisitions division, the air traffic service division, and regulation and certification.

Even in the present organization, the only person with authority above those three levels is the administrator. So the administrator could be the person responsible, but there are lots of other things that take the administrator's attention.

Mr. TANNER. Thank you.

Mrs. MORELLA. Mr. Tiahrt.

Mr. TIAHRT. Thank you, Madam Chairman.

I think there's a lot of skepticism, I should say, about how things are going for the AAS, for example. I think this is kind of indicative of your concerns of management, technical problems.

Dr. Dillingham, do you see in your research—I want to address—you know, you mentioned the 777 and the lack of technical expertise. I'm not sure that the government needs to have people who are qualified to design systems for glass cockpits and that nature.

But they certainly do need to know good systems engineering practices, how to establish milestones, how to make sure requirements are meeting the needs. And I think that's what you're expressing now, pretty much, that we haven't set up a good set of ground rules to start from, and then we're not tracking progress.

Have you seen anything in the system that establishes configuration control, that interface with management? You've got three groups now, as I understand, this terminal tower and en route, or as we approach this air traffic control problem? Is there an integration system that you see in place that, when those three systems mesh, who establishes the interface on one side and the other, and how is it brought together?

There's something in place. I mean, I guess I'm looking for some confidence that these problems that we've seen in the past are not going to reoccur in the future.

Mr. DILLINGHAM. We haven't looked at the new arrangement, the new contract, yet. But we've been sort of observing it from afar. I'm not sure we can give you much confidence at this point that some of the same things may not occur again. That's why we argue for this continuous monitoring and oversight.

We're hopeful that FAA's bringing together research and development and acquisition and the new contract will indeed have a positive effect. We can't give any assurances of that at this point.

Bob, can you speak more to that?

Mr. LEVIN. There is configuration management at FAA. And there's also a support contractor, TRW, whose purpose is to make sure the systems are integrated. It used to be Martin Marietta. The contract switched over to TRW. So there are some mechanisms there in place at a program level, and also at FAA level, with configuration management that's there to ensure that systems work together.

There is not a very good record, however, I must say for several systems. One that comes to mind is long-range radar, where still FAA is yet to build—and Westinghouse, its contractor has yet to build a system that could interface well with other systems that it must work with.

So it's a continuing challenge for FAA.

Mr. TIAHRT. When you are reviewing the procurement process, is there some flow chart or some critical path or some means of tracking when certain milestones, parallel efforts that are going along, come together that those are being met in a timely fashion? How is it managed now? Is it just completely turned over to the contractor? Are there monthly program reviews?

Mr. LEVIN. No. There's monthly reviews, major projects. And they look a little bit different, depending on the system and the contractor. But, yes, there are monthly reviews.

Mr. TIAHRT. There's an article out of the Business Commercial Aviation, August 1994, where they interviewed a Del Bolzo. He made a statement in here that, "We must have complete overhaul of our acquisition process," referring to the FAA.

Is there a process, a procurement process that you guys see in the government that would be adapted to the FAA procurement process to help them in managing better, both technically and in the management area of looking over a program, the contractor's shoulder, seeing that these milestones are met, that we don't have overruns and schedule slides?

We have the federal acquisition regulations. Other agencies have their form of that similar document. Is there one that could be adapted for the FAA that would help them with this oversight process?

Mr. LEVIN. I think FAA has the systems in place now to provide the oversight. It's a question of follow-through. I think Mr. Dopart's point about continuity and leadership is essential. There's been too much turnover right when somebody in the administrator's office or the acquisition executive gets a handle on the problems, and they're gone. So I would emphasize the continuity also.

But there are systems in place. It's a question really, it's up to the individuals to make sure it works. And I'll also go back to the point about overly ambitious programs. Where FAA has had a lot of success is with proven technology. The automated weather observing system, the system control center out in Herndon, these were proven technologies where there wasn't a lot of software that had to be developed. It's easier for FAA to bring those home.

If you're trying to design something that's brand new and that's kind of a leap in technology, that's where FAA has really had its problems.

So regardless of what kind of configuration management you have or other systems, you're really running some risks.

Mr. TIAHRT. I've got one last question for Mr. Dopart.

You mentioned that they have now started to use integrated product teams, did you call them? And do you see—are they taking users as well as the technical developers and the manufacturers, and is it as very broad group, or is just a narrow focused group? How are they structured?

Mr. DOPART. From my understanding, and we have not looked closely at integrated product teams. Those were developed after the publication of our report. My understanding is that they are made up of FAA people only. So it's an internal group. I think there are provisions.

And FAA has done this in a previous team effort called the satellite operational implementation team, where, as they develop procedures for satellite navigation, they brought in all elements of the FAA, as well as industry, including pilots and manufacturers.

That process can work until it reaches the regulatory stage, and then industry has to step back.

For the integrated product teams, I'm not sure, but I would think it would be a good idea to include industry to the extent possible.

Mr. TIAHRT. Thank you, Madam Chairman. I would like to, if you would pass onto your senior management, next time I'd like to see an American product. I'm into exports and imports, mostly exports.

Mr. DOPART. Yes, sir. We made sure we had a Boeing representative on our panel. [Laughter.]

Mr. TIAHRT. Okay.

Mrs. MORELLA. Very good.

Ms. Johnson.

Ms. JOHNSON. Thank you, Madam Chairman. I just had one question.

I've had at least two people to come to my district office to complain that, with the FAA, many of the staff people that write guidelines to send out RFPs and all for contracts end up resigning and submitting proposals themselves. I don't know if that's accurate or not. But could you give me some indication as to whether you might be aware of anything like that?

Mr. DILLINGHAM. We are not aware of anything like that. But certainly there are individuals who have left the Agency and have gone out on their own, or gone to private sector companies. But in terms of what actions they took from the Agency and took with them, we're not aware of any, Ms. Johnson.

Ms. JOHNSON. Thank you.

Mrs. MORELLA. Okay, thank you.

I'd like to now turn it over to Mr. Calvert, who is the Vice-Chairman of this Committee, for any comments or questions he may have.

Mr. CALVERT. Thank you, Madam Chairman.

I am sorry to miss the opening testimony. I was able to brief some material.

It seems that the consistency here that there's not a problem with the lack of technology—it seems that we have a lack of management over at the FAA. And certainly, if there's a crisis, it's not with the technology, it's with the management at the FAA.

It seems that over the last 35 years we have a change of management every couple of years, a lack of continuity. And this certainly has cost the United States Treasury a considerable amount of money.

I understand that since 1983, we have spent $2.3 billion for technology upgrades. And I understand there's a cost overrun of approximately $1.2 billion right now. Is that correct?

Mr. LEVIN. You're referring, sir, to the advanced automation system, I believe?

Mr. CALVERT. Yes.

Mr. LEVIN. In terms of FAA's overall modernization program, the expenditure is more like $20 billion.

Mr. CALVERT. Excuse me. And I was just briefly going over some recommendations here. But obviously, we need dramatic and major change quickly at the FAA. Would everyone agree to that?

[No response.]

Mr. CALVERT. There's no disagreement there?

Mr. DILLINGHAM. No disagreement from us.

I think one point that we should make is that FAA realizes the sting that it took on the AAS system, and that what the Agency is trying to do now, it's trying in a number of ways not only to reform itself by bringing the R&D and acquisition under one office, but also it's trying to make sure that the same thing doesn't happen again.

As we said before, it's a matter of follow-through.

Mr. CALVERT. But more than that, is there a culture at the FAA that that can be changed? Is the structure there so rooted in that type of managerial style which is obviously a failure, can it change with the existing people in command there now?

Mr. DILLINGHAM. There certainly is a cultural problem. The problems certainly are resistant to change.

Again, I think the Secretary of Transportation testified a few months ago that during the past 10 years there have been 2 dozen changes of management styles or approaches at FAA. And the problem still persists.

FAA also recognizes it has a cultural problem, and it's trying to get to that root cause now through trying to find ways to break some of the stovepipes, the sort of linear way things are done, and bring more people in.

So everyone recognizes it. Everyone agrees that there's a cultural problem there. Again, it's to what extent can you break that? It's a very, very difficult thing to do.

Ms. SCOTT. If I might add, it's not only a problem with the management of FAA's technology programs for its air traffic control, but an oversight or a management of the aviation system. And to address in part Ms. Johnson's question about who's looking at the condition of the system, this is where OTA finds a need for FAA's continuous observance of system performance, system problem indicators, et cetera, that are essential to the development of ATC products as well as the management of the system as a whole.

And any progress in that area would be strongly encouraging.

Mr. CALVERT. Well, I would just close by saying I understand that there has been five reorganizations at the FAA since 1989. Obviously none of them worked. And hopefully, as we move forward on this, the next one does work, whatever is done over there. And I think that I'm grateful to the Chairlady for having this hearing, and look forward to looking into the future of the FAA.

So with that, thank you very much.

Mrs. MORELLA. Thank you, Mr. Calvert.

Ms. Lofgren?

Ms. LOFGREN. Thank you, Madam Chairwoman.

Many of my questions have already been asked. But I've been thinking about this, and I want to try out an idea and get your preliminary concept on whether something like this might work.

When we have, at other parts of government, very large sort of project-oriented tasks to achieve—I mean, there's a variety of ways organizationally to do that. One is to have a government agency filled with civil servants with a high level appointee at the top.

Another model is to have a smaller number of government employees that might even be paid at a higher level and recruited in a different manner.

But to retain a large firm to assume some of the management and technical expertise that might have depth and the ability to move people in and out, that just inherently is not possible in government.

For example, I was just telling my colleague from Texas about a $1 billion project that we did when I was in local government, which we did with a top inside staff of five people, and hired, not that they're the only firm that could do it, Bechtel to come in and provide management expertise and technical expertise with people that changed over time as the project changed.

Do you think something of that nature, assuming the rules of the federal government, could be changed to allow it might work in this situation?

Mr. DILLINGHAM. That certainly is an alternative that we think has some merit, Ms. Lofgren. And in fact, FAA is sort of doing that in the sense of, most of the work is contract work.

But the problem, or at least part of the problem, is that cadre, that core of people within the Agency has to have some continuity and has to have the right mix of skills in order to oversee the contractors.

And that's sort of where in some ways FAA has a deficit, is that they need not only some technical people, but they need people with a great deal of contract management skills, or we will have a situation where you have a contractor and the process goes on, and it's not going along the proper way. Someone has to be there to make sure that that happens.

Ms. LOFGREN. Well, just to follow up on that, in this example—and I'll use Bechtel because that's who we use—they were not—they were precluded from being a vendor or providing any of the actual substance. Their whole role was management. And we looked on them as part of our management team.

And so the internal people who did to some extent change were merely partners with the other part of the management team that was contracted, and had the ability to move in some expertise that were not available in the public sector.

Would that change your answer?

Mr. DILLINGHAM. Yes. That would put a different flavor on it, as I understand what you're saying now.

Ms. LOFGREN. Let me ask you, in terms of procurement generally. I think that's been an issue. What would you recommend, assuming, aside from creating a different government entity, there's no reason why we couldn't change procurement policies within the Federal Government itself, and in fact probably that should happen throughout the Federal Government.

What specific recommendations would you make for changing the entire procurement process here?

Mr. LEVIN. Yes. As you know, the administrator has been going around the country arguing for an air traffic control corporation. And GAO hasn't taken a position on that. But our response has focused on the procurement and personnel rules, to some extent, because they are cited as getting in the way of FAA's modernization program.

So our questions were, well, specifically what procurement rules, what title V personnel rules are causing problems? What new rules then would you put in its place? And then, how would those new rules help you, as opposed to the old rules which are creating a problem? And try to get those kind of specifics as opposed to, "Well, we just need to be freed from these rules."

So we've posed that question. We don't know the answer. We were hoping FAA would come up with the answer. These particular rules were creating problems for them. You know, it could be the Brooks Act. I'm not sure which rules we're talking about.

Ms. LOFGREN. Well, you could make horrible mistakes with no rules, and you can make horrible mistakes with a lot of rules and everywhere in between.

Mr. LEVIN. Exactly.

Ms. LOFGREN. Is there a process underway to identify a system that would yield timely, cost-effective, appropriate technology?

Mr. LEVIN. Certainly FAA has an approach, has the management systems in place that they think will deliver the technology that they need. Again, it comes back to good management and smart decisions. I'm not so sure it's the system. And GAO has pointed out over the years that it's been a management problem. It hasn't really been the rules that have gotten in the way.

Mr. DOPART. If I may add, there's one additional difficulty. And this issue hasn't been discussed much today. And that with the air traffic control system. It is complex. And the key issue is safety. And it's quite safe, extremely safe.

So in delivering a new technology, a new system, the first thing you must ensure is that safety is not degraded. It's pretty difficult to improve safety much further. That's always a goal.

But the big benefit is economic return. There could be billions of dollars saved if a full new system's in place. But to ensure that level of safety is always going to take time, and very few of these pieces of equipment are off-the-shelf. Ideally, it would be nice to move it to a system where more components could be bought commercially. But in the present system, they're developed from scratch.

And the acquisition process today focuses on technology. It does not really focus on that safety, operational analysis aspect. We buy technology. We don't buy safety analysis, operational procedures. We don't buy new regulatory system. That's done inside government.

Ms. LOFGREN. Thank you, Madam Chairwoman.

Mrs. MORELLA. Thank you.

Mr. Gutknecht, would you like to pose any questions?

Mr. GUTKNECHT. Thank you, Madam Chair, and I'm sorry I had to leave for a little while, and so I've missed some of the testimony. But there are a couple of questions I'd like to ask this panel if I could.

First, in the 1994 report, Federal Research and Technology for Aviation, the report says that "The FAA has claimed to have overcome the system development acquisition hurdles a number of times during the past decade."

As I mentioned in my opening statement, one of the goals we have to have is that we don't come back or some Congress comes back 4 or 5 years from now and say, "Well, wait a second. I thought we had solved these problems."

Do you feel this time that the FAA is at least on course to solve some of the problems we've been hearing about?

Mr. DOPART. Well, they've made one step in setting up integrated product teams. But in our report, we set three—or conclusions where three criteria are necessary. One is to have stable, accountable leadership. A second is to have strong operational focus. A view of the system is not just technology but a broader perspective. The third was to create multidisciplinary teams for product development.

FAA has done the last item. The first two—well, obviously the stable leadership issue is still unknown. The operational focus, that's a possibility and that's something this committee can continue to maintain oversight in the year to come.

Mr. GUTKNECHT. Madam Chair, I attended a briefing back toward the beginning of the session. And some of the people who were there—and I don't remember the exact quotations—but certainly left the impression that all of the major problems were behind us, and that the system was about 75 percent ready to go.

Was that accurate? Was that a distortion? What's your assessment?

Mr. LEVIN. Well, in terms of the FAA modernization program, we annually report on the status of that program, and talk about the number of systems that are completed, and the number of systems that are still under development.

FAA has completed about 64 projects, but they comprise a very small percentage of the overall spending on the modernization program which now totals $37 billion.

Major systems, such as AAS, voice switching and control, long-range radar, and I could go on and on. These are not either fully commissioned or even partly commissioned. There's a long, long way to go.

I once described it in a newspaper article as a trip from New York to Los Angeles. The FAA thought they'd be in Denver by now, but they were only in Cleveland. I think they're probably in Indiana by now, but they still have a long way to go.

Seventy-five percent would not coincide with my assessment at all, sir.

Mr. GUTKNECHT. Madam Chair, I am not a scientific project manager or anything like that, but I do remember in college learning about program evaluation review techniques, where you literally set up a chart. If you want to get from point A to point B, ultimately all the critical tasks that had to be performed in between.

Are you satisfied that they have such a plan in place? Because as I understand, for example, with doppler radars—I mean, there are a number of them that are sitting in crates around the country that either cannot or have not been set up. And there's a lot of work between now and getting them out of the crates and actually doing some work to help protect the public.

Mr. LEVIN. Yes, there's been a breakdown. It's always something. [Laughter.]

In the case of TDWR, the doppler weather radar, they have been unable to find suitable sites for some of these. Now, you think that would be one of the first things that these integrated product teams would want to tackle in the future, and hopefully FAA will make sure everything as they say, from cradle to grave, is covered so they have that critical path lined up.

But certainly the record has been a bad one.

Mr. HAMPTON. And I'd like to add that only in many cases half the problem is developing the technology. The remaining problem 30–40 percent, is actually implementing it.

A good case is, FAA has got a pretty good detection system for detecting explosives in checked baggage. That's half the battle. Actually implementing it at airports is a tremendous task, and it may be one of the major issues the airline industry faces.

That sort of thinking has to go early on in the process of developing technology. Again, I think you've heard that theme today. Operational perspectives—again, it's only a small part is developing the technology. The next step is placing it in day to day operational use.

Mr. DOPART. And if I may follow up on an additional point that Mr. Levin made, in his analogy of getting from New York to Los Angeles.

Based on the current modernization plan, the old NAS plan and the capital improvement program, when FAA reaches Los Angeles, still for the airline users of the system, there are really no new functions in the system.

FAA will have better technology on the ground that will work better, with lower costs. But an airline will still fly the same point to point dog-leg approach that it has. There are considerations now independent of this for the free-flight program which will allow an airline to fly the most fuel-efficient, time-efficient path.

That is not part of the air traffic system now, and a change of that nature hasn't happened for over 20 years in the air traffic control system.

Mr. GUTKNECHT. What's it going to take to get us to get, to think more boldly, and to think more consumer-friendly, or whatever the answer is? What will it take? What should this Congress do to try and encourage that kind of thinking?

Mr. DILLINGHAM. Well, this committee has already taken that step by encouraging and mandating that FAA do more long-term research, that in fact part of the RED budget, at least 15 percent of it be devoted to long-term research.

The point now is that that long-term research from FAA's perspective shouldn't be reactive, but be more proactive. A lot of the long-term research that we see going on now resulted from reaction to incidents like the Aloha Airline incident. And we started to have more research on aging aircraft.

And when we had the incident where the airport or one of the people at the airport got aboard a plane and injured the pilot and others, then we had more on security access.

So the committee has made the first step in pushing FAA towards long-term research. FAA now has to focus on that vision-type thing, rather than be reactive.

Mr. GUTKNECHT. Thank you, Madam Chair.

Mrs. MORELLA. Thank you.

I know that Mrs. Myrick has joined us. I think she's going to pass on this first round.

I'd like to ask a couple of other questions to you all.

One thing that troubles me is that, as I learned about the runway incursion system that, like the radar is pretty much in order. The computers are an important component of it. The computers are not zero, which means that the runway incursion system becomes nonfunctional.

Wow. What a kind of fragmented, inefficient situation. Would any of you like to comment on that? I mean, do you see this as a problem? This is not part of the major problem that we have, things not working together, maybe because of lack of management expertise?

Mr. HAMPTON. On the issue of runway incursions, one recent technology—it's called airport movement—I can't remember the acronym. It's AMAS. And I think it comes back to an issue that OTA and we have discussed, the operational environment.

FAA developed a very complex system to enhance its ASDE radar to alert controllers of impending problems on runways. And controllers weren't sure they really liked it. And how would alarms going off in the control tower affect their performance?

And I think that's something that had to be—should have been figured out a lot earlier in the game, before they went further to that stage with AMAS.

So again, I think it comes back to the question of, how does something work in the day to day environment? How are controllers really going to work with it? And that's what something has to change in FAA, how it actually works in the environment and how the human being actually works with the new technology.

I hope that answers your question.

Ms. SCOTT. And that factor must be considered across all of the air traffic control operations. Not air traffic modernization programs alone, but as you incorporate airport safety, aircraft safety efforts into that mix as well, what will the new system look like? What are the needs going to be?

Mrs. MORELLA. It certainly needs some close scrutiny and monitoring.

I was just handed an article in Newsweek that you probably saw, April 24th of this year. And it says, "The FAA promised Congress it would have AMAS operational by 1992. But AMAS has since turned into a mess."

Would you agree with that strong statement?

Mr. HAMPTON. AMAS has some problems. I'll leave it at that.

Mrs. MORELLA. Okay. Well, we'll talk to our FAA representative soon about that.

Also, you mentioned in the testimony GAO that the FAA funds a lot of its R&D from its facilities and equipment account. I just wondered if you wanted to comment on that, because whereas one might think they don't have enough from R&D, they're actually using the other account. Is that correct?

Mr. DILLINGHAM. Yes, that's correct. They are funding some R&D from the F&E account. But that R&D basically is the R&D associated with air traffic control modernization, as opposed to the R&D that's associated with some of the other areas in the RED account.

Ms. SCOTT. A sizable portion of that, the weather research, however, does come from the facilities and equipment account, although there is a component related to actual science, atmospheric science. The weather's funding within the RED account is minuscule.

Mrs. MORELLA. I'd like to just ask you if you have any comments on how Loral is doing with the program, the AAS program. A lot of that's been in my district, as you know. [Laughter.]

Mr. LEVIN. Right. Time will tell. Certainly they've taken some strong actions, replaced the management team, put some new systems in place to monitor their progress, and make sure they are doing things the right way, make up for a lot of their past mistakes.

But as we pointed out, last month, or the month before last in our testimony before the Appropriations Committee, there are still a number of problems with the software that have to be addressed, and time will tell. We're all keeping our fingers crossed.

But it takes more than just hoping for good luck. Obviously, it takes good management and continuity and keeping the eye on the ball.

Mrs. MORELLA. I wanted to ask if anyone else on the subcommittee would like to follow through with any questions. If not, we will then proceed with our second panel.

I want to thank you all very much. And I hope that you'll be open to any other questions we may have subsequent to this first oversight hearing. Thank you very much.

And now I'm going to turn to the Federal Aviation Administration for their response, pretty much, and statements. Dr. George Donohue, who is the Associate Administrator for Research and Acquisition. And Dr. Donohue is going to be accompanied by Mr. Andres Zellweger, who is the Director of the Office of Aviation Research, and Mr. Clyde Miller, who is the Program Director for Research of the Office of Aviation.

Mr. Zellweger, did I pronounce your name right?

Close. Thank you very much for appearing.

In addition to your testimony that you had planned, you've heard some of the questions that the subcommittee has posed, and I think it would be quite appropriate if you want to comment in response to any of those.

So, Dr. Donohue, nice to see you. Thank you.

TESTIMONY OF DR. GEORGE L. DONOHUE, ASSOCIATE ADMINISTRATOR FOR RESEARCH AND ACQUISITIONS, FEDERAL AVIATION ADMINISTRATION; ACCOMPANIED BY ANDRES ZELLWEGER, DIRECTOR OF THE OFFICE OF AVIATION RESEARCH; AND CLYDE MILLER, PROGRAM DIRECTOR FOR THE RESEARCH DIVISION, OFFICE OF AVIATION RESEARCH

Dr. DONOHUE. Thank you very much, Madam Chairman.

There were an awful lot of questions, and I would actually welcome to come back after my prepared statement to address any and all of those. If I forget any of them I would certainly welcome any of the members of the committee to bring up what you think are outstanding questions, we'd be happy to address those.

Chairwoman Morella, Members of the Subcommittee, I appreciate the opportunity to appear before the committee today, discuss the FAA's Research, Engineering, and Development Program. With me today are Dr. Andres Zellweger, he's Director of the Office of Aviation Research, and Dr. Clyde Miller from the same office.

We provided a longer statement for the record, but would like to summarize this statement for the Subcommittee.

Last summer, Administrator David Hinson asked me to come to the FAA to pull together the research through acquisition process. One of our main goals was speeding up the delivery of technology to the field to meet our customers' needs.

I brought to the FAA a broad experience in managing major research and technology projects in both the public and the private sector. Before joining the FAA, I was a Vice-President at the Rand Corporation, Santa Monica, California, where I directed Project Air Force. And in that capacity I supervised the research, quality control, fiscal management, and technical oversight of the Air Force's federally funded Research and Development Center for Policy and Analysis.

I might add that we did considerable amount of analysis on the research, development, and acquisition process in both the federal and in the public sector, or the private sector.

I'm also currently a member of the Rand graduate school faculty in Public Policy, and my specialty is in research and acquisition policy.

Prior to that position at Rand, I was Director of the Aerospace and Strategic Technology Office of the Defense Advanced Research Projects Agency in the Department of Defense. In that position, I provided technical, fiscal, and management oversight of a wide range of very high technology programs.

My private sector experience also includes five years as Vice-President of Dynamics Technology, Incorporated, a high-tech research and development firm in Torrance, California.

As the FAA's Associate Administrator for Research and Acquisition, I'm in charge of a 2,000-member organization responsible for research, design, development, acquisition and implementation of the infrastructure of the national airspace system.

The national airspace system is an extraordinarily large and complex system that serves not only the airlines but also more than 175,000 general aviation aircraft, which includes business aircraft, medivac operators, and private aircraft. In addition it must accommodate the needs of some 10,000 military aircraft.

A modernized national airspace system is critical to an industry that in turn is vital to the nation's economy. Aviation and related industries contribute nearly $700 billion yearly to the economy and provide over 8 million jobs.

Over the years, FAA's research, engineering, and development activities have played a vital role in helping the United States to establish the safest and most efficient aviation system in the world. I will also add that two weeks ago I was in Europe addressing Eurocontrol. And they pointed out to me that the U.S. air traffic control system has twice the productivity of the European system, an interesting statement.

Today's FAA valuable research, engineering, and development work continues at our technical center in Atlantic City, New Jersey, and in cooperative research partnerships with industry, universities, NASA, the Department of Defense, and other government agencies around the country and abroad.

I have provided for the record a summary of the major 10 areas in our current program, and as you will see, it covers the gamut from aircraft and airport safety to improvements in communications, navigation, surveillance, which are the cornerstones of air traffic management.

The site, despite the notable successes in FAA's research, engineering and development over the years, what I found when I came to the FAA last year was a program out of step with today's realities. The question was not whether the FAA had made valuable contributions to aviation in the past. It was whether the FAA's organization and processes were in line with the rapidly-changing world of technology and the dynamic needs of our customers at a crucial juncture in the Agency's history.

The FAA is facing an enormous challenge. At a time of shrinking federal resources and growing customer demand, we must replace aging equipment and systems on a broad scale throughout the entire airspace system, in the tower, the terminal, en route, oceanic areas, and we must do this in the most economical way possible.

Traditionally, FAA acquisitions were geared to a major systems acquisition approach, very much of a Department of Defense model. It was based on an assumption of a 15- to 20-year technology life cycle. This was prevalent in the '50s and the '60s, and perhaps even the early '70s.

But today, with computer technology life cycles, which are on the 18-month to 3-year time scale, the Agency was in the position of having to speed up its systems to make sure equipment was not outdated by the time it was installed. To do this, we had to improve our ability to bring technology from successful R&D into the system's acquisition and later deployment process at a much more rapid pace.

As a start, I put in place a new organization last fall. We are now changing our processes to go along with this new organizational structure. The new organization pulls together research, prototyping, system development, and acquisition activities at the FAA into a seamless process.

We have replaced the previous stovepipe organization with a flatter, more horizontal structure. Key to this new organization are integrated product teams, which bring together representatives from disciplines such as research, air traffic, airways facilities, logistics, system and specialty engineers, lawyers, contracting officers, and industry to focus exclusively on developing products.

These teams have responsibility for a product throughout its life cycle. Team representatives from the air traffic operating and maintenance services are crucial, since they help identify functional requirements from the very beginning of the process.

I will add that much of this reorganization was geared towards addressing exactly the problems that GAO and OTA have described to you in earlier testimony, much of which I concur with.

Also critical to the process is early and sustained involvement on the part of our customers: representatives of general aviation, business flying, and the airlines. We must have them at the table from the beginning to help us define requirements, and then work hand in glove with us throughout the development and implementation phase to make sure we stay on track.

I will add that this is more difficult in the government environment than it is in the private sector, because of acquisition laws that preclude sharing of certain information with the contracting public community prior to acquisition decisions, and also because of disclosure of budget information, which any businessman would share with his customers, where we are precluded from doing that.

In addition, as part of our reformed acquisition process, we are getting away from costly and time-consuming system development approach, unless we have to develop the system ourselves. This represents a major cultural change from the former mentality that said, if the FAA didn't design it and develop it from scratch down to the last detail, it would not serve the FAA's purposes.

Instead, we are now moving towards purchasing commercial, off-the-shelf items whenever possible in adapting equipment and systems to meet unique FAA operational requirements as needed.

I assure you that I understand that no organizational structure is a panacea in and of itself. What is key, no matter what the organization looks like or what you call it, is a committed management team using rigorous evaluation tools to make sure the organization meets its goals.

We believe we have put those essential elements in place. A strong research, engineering, and development program is vital to achieving our shared vision of a safe, efficient, and economic air traffic control system into the next century, and well beyond.

I have personally promised to stay a minimum of five years at the FAA in this position to be assured that we can accomplish this task. I agree with the previous testimony that a continuity of management oversight is required and has been lacking at the FAA.

That completes my prepared statement. I would be pleased to address any questions you may have. But, Madam Chairman, if you would like me to address a few of the points that were brought up prior to that, I can comment to those now.

[The prepared statement of Dr. Donohue follows:]

STATEMENT OF GEORGE L. DONOHUE, ASSOCIATE ADMINISTRATOR FOR RESEARCH & ACQUISITIONS, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON SCIENCE, SUBCOMMITTEE ON TECHNOLOGY, CONCERNING THE FAA'S RESEARCH AND ACQUISITION MANAGEMENT ORGANIZATION. MAY 16, 1995.

Chairwoman Morella and Members of the Subcommittee:

I appreciate the opportunity to appear before the Subcommittee today to discuss the FAA's research, engineering and development (RE&D) program. With me today are Dr. Andres Zellweger, Director of FAA's Office of Aviation Research, and Dr. Clyde Miller, from the same office.

Last summer, FAA Administrator David Hinson asked me to come to the FAA to pull together the research through acquisitions processes with a major goal of speeding up the delivery of technology to the field to meet customer needs. I brought to the FAA broad experience in managing major research and technology projects in the public and private sectors. Before joining the FAA, I was a vice president at the Rand Corporation where I directed Project Air Force, overseeing research, quality control and financial management of the Air Force's Federally Funded Research and Development Center for policy and analysis. Previously, I was director of the Aerospace and Strategic Technology Office of the Defense Advanced Research Project Agency (DARPA). In that position, I was responsible for providing fiscal and management oversight of a wide range of programs, including the low cost GPS/fiber-optic-gyro navigation system, the X-31 experimental fighter aircraft and the Pegasus space-launched vehicle program. My private sector experience includes five years as Vice President of Dynamics Technology, Inc., of Torrance, California.

As FAA's Associate Administrator for Research & Acquisitions, I am in charge of a 2,000-member organization responsible for research, design, development, acquisition, and implementation of the infrastructure of the national airspace system. This organization includes engineers, scientists, technicians, analysts and managers.

The national airspace system is an extraordinarily large and complex system that serves not only the airlines, but also more than 175,000 general aviation aircraft -- business aircraft, medivac operators, and private aircraft. In addition, it must accommodate the needs of some 10,000 military aircraft.

There are 25,000 facilities in the airspace system, and we are continually in the process of updating or replacing equipment. Included in this inventory are some 470 air traffic control towers; 21 air route traffic control centers handling traffic in en route airspace between airport terminal areas; and a network of 130 or so flight service stations providing a variety of preflight and in-flight information services, such as weather briefings, mostly for the general aviation community.

A modernized national airspace system is critical to an industry which in turn is vital to the Nation's economy. Aviation and related industries contribute nearly $700 billion yearly to the economy and provide 8 million jobs. In a single day, the national air traffic system handles upwards of 200,000 takeoffs and landings at airports across the country. U.S. airlines fly some 500 million passengers per year. This figure is expected to jump to 800 million over the next decade and reach the billion mark by the year 2015.

Over the years, FAA's research, engineering and development activities have played a vital role in helping the United States establish the safest and most efficient aviation system in the world. Today, FAA's valuable research, engineering and development work continues at our Technical Center and in cooperative research partnerships with industry, universities, NASA, the Department of Defense and other government agencies around the country and abroad. Attached is a list of the ten major program areas in our current RE&D program. It covers the gamut from aircraft and airport safety to improvements in communications, navigation and surveillance which are the cornerstones of air traffic management.

Despite the notable successes in FAA's RE&D program over the years, what I found when I came to the FAA last year was a program out of step with today's realities. The question was not whether the FAA had made valuable contributions to aviation in the past. That was a given. It was whether the FAA's organization and processes were in line with the rapidly changing world of technology and the dynamic needs of our customers at a crucial juncture in the agency's history.

The FAA is facing an enormous challenge. At a time of shrinking Federal resources and growing customer demand, we must replace aging equipment and systems on a broad scale throughout the entire airspace system -- in the tower, terminal, and en route areas -- in the most economical way possible. Traditionally, FAA acquisitions were geared toward a major systems approach, based on the 15-20 year technology life-cycles prevalent in the 1960's and 1970's. With the computer technology life-cycle now down to 2-3 years, the agency was in the position of having to speed up its systems to make sure equipment was not outdated by the time it was installed. To do this, we had to improve our ability to bring technology from successful R&D into system acquisition and later deployment. These are the kinds of problems that the Administration's air traffic control transfer legislation tries to address, by providing broad procurement, personnel and budgetary relief for the air traffic control system.

Until we can bring about this change, we are doing everything we can to make the existing system work better. As a start, I put in place a new organization this past fall and we are now changing our processes to go along with this new structure. The new organization pulls together research, prototyping, system development and acquisition activities at the FAA into a seamless process. It provides integration across functional lines and replaces a hierarchical, stovepipe organization with a flatter, horizontal structure which emphasizes empowering employees and placing decision-making and accountability at the lowest levels.

Reporting to me are seven senior managers in charge of programs developed along product, rather than functional, lines. Key to this new organization are integrated product teams (IPT) which bring together representatives from functional disciplines: specialists in research, air traffic, airway facilities, and logistics; testing and contract personnel; system and specialty engineers; lawyers, and others, to focus exclusively on delivering products. These teams have responsibility for a product throughout its life-cycle. This responsibility stretches from applied research through acquisition and beyond, to the point of making sure that products are up and working properly after they have been delivered and installed in the field. Representatives from the air traffic operating and maintenance services are crucial members on the teams since they help identify functional requirements from the very beginning of the life-cycle process.

Also critical to the process is early and sustained involvement on the part of our customers -- representatives of general aviation, business flying and the airlines. We must have them at the table from the beginning to help us define requirements and then work hand in glove with us throughout the development and implementation phase to make sure we stay on track. In the past, time and money were sometimes spent inefficiently in major system acquisitions by not having our customers involved early and often. As a result, we ended up in what I call a "requirements churn," whereby changes were constantly being inserted into the development process. With integrated product teams, we have everybody around the table from the very beginning to agree on the requirements.

In addition, we are getting away from the costly and time-consuming systems development approach, from an outdated view that if the FAA doesn't design it and develop it from scratch down to the last detail, it won't serve our purposes. Instead, we are moving towards COTS/NDI acquisitions -- shorthand for "commercial off-the-shelf, non-developmental items" -- whenever possible, and adapting equipment and systems to meet unique FAA operational requirements as needed.

Before I move away from discussion of the organization, I assure you I understand that no particular organizational structure is a panacea in and of itself. What is key -- no matter what the structure looks like or what you call it -- is a committed management team, using rigorous evaluation tools to make sure the organization is meeting its goals. We have the systems in place and, as I said last fall when setting up the new organization, I plan to take a careful look at it after one year and make whatever changes are necessary. And I will not hesitate to do that. In the meantime, we are keeping a close watch on the integrated product teams to make sure they are working as planned.

Here are some of the mechanisms we have put in place that will help us do the day-to-day assessments.

- **Office of System Architecture and Program Evaluation**: One of the major responsibilities in our organization, this office is designed to make sure that everything we do is consistent with an overall airspace system architecture that we are developing with industry. Another vital function of this office is to provide an on-going independent review and evaluation of other ARA programs.

- **Business Plan**: Like all the organizations in the new FAA structured along business lines, we are developing a business plan pegged to the seven strategic goals of the agency. Each of these goals has a set of metrics, a yardstick to help us measure our progress in meeting the goal.

- **Technical Performance Metrics and Result Oriented Metrics**: In conjunction with the metrics in our business plan, we are continuing to make improvements in reporting for internal use the costs, milestones, and technical achievements of the various programs. And, pursuant to the Government Performance and Results Act (GPRA), . we are setting up a series of result-oriented measures that relate our activities to larger goals. Using these measures, we will consider issues such as these: How are safety and productivity improved? How will this affect system capacity and efficiency?

- **Cultural Baseline Survey**: We surveying our employees to help understand how our organization's structure and culture support each other, in addition to identifying ways to improve how we do business.

- **Major Acquisition Reviews (MAR)/Acquisition Review Committee (ARC)**: We have restructured our major acquisition reviews for senior executives along integrated product lines so that related programs are reviewed simultaneously, rather than on an individual, piecemeal basis as they were in the past. MAR's are primarily informational in nature, to provide senior executives status reports on program. ARC's, on the other hand, are decision-making meetings where senior executives make a determination whether to proceed with a program.

- **Process Reengineering**: We have established a mechanism for examining our processes, particularly those that relate to acquisition management and information technology. I am convinced that FAA's effectiveness depends more on its processes than on its organization, so we are paying very close attention to this issue and will follow up to make sure these process changes are effectively implemented.

A strong, focused RE&D program is vital to achieving our shared vision of a safe, efficient air traffic control system into the next century. I am committed to staying a minimum of five years at the FAA to see this through -- to developing an integrated process, from research through acquisitions, that enables us to speed technology to market in time to meet customer needs and as economically as possible.

Attachment

Principal R&D Program Areas

- One program is devoted principally to the development of the information processing, or automation, systems that support air traffic controllers in assuring the safe and efficient movement of air traffic. Implementation of effective automation capability is essential for modernizing the air traffic management system.

- A second principal program area is concerned with further developing the communications, navigation and surveillance utilities that are the cornerstones of the air traffic management process.

- Our efforts in aviation weather are closely coordinated with the National Oceanic and Atmospheric Administration with the objective of assuring the development of weather products unique to the needs of the aviation community, such as reliable icing forecasts. And we work with the National Aeronautics and Space Administration in windshear detection and avoidance and in better understanding aircraft wake vortices.

- Airport technology R&D is focused principally on the development of cost-effective pavement designs and safety enhancements for the airport surface, including arresting systems to safely stop aircraft that overrun runways.

- The aircraft safety technology area is concerned with understanding hazards to aircraft in flight, developing systems and techniques for mitigating these hazards, and providing the results of this research to the user community in the form of technical information and advisory circulars.

- The agency has an aggressive program in aviation security to develop effective means of preventing acts of terrorism against civil aviation. Initiatives include explosive detection systems, hardened baggage containers, and improved passenger screening systems.

- The human factors research program has two focal points: research and applications. Research efforts strive to improve our understanding of human capabilities. Applications work applies what we know to improve selection and training, procedures, fatigue countermeasures, charts and publications, and the human interface with aviation systems.

- FAA efforts in the area of environment and energy strive to balance the benefits of air transportation with its environmental impacts. In particular, the program further develops our understanding of the effects of noise and air pollution emissions on people and the environment, and works with the national and international aviation communities to mitigate these effects.

- The agency has established extensive R&D partnerships with universities, industry and other Government agencies, and one of our program areas is devoted entirely to this subject. These partnerships leverage FAA R&D investments with contributions for the other sectors, foster new approaches and innovative solutions to R&D challenges, and develop a pipeline of younger people interested in aviation R&D and able to contribute.

- Finally, we have a program area focused on program management, including planning, budget formulation, and review. This area also supports the FAA RE&D Advisory Committee process as well as simulation laboratories at the FAA Technical Center.

Mrs. MORELLA. That would be appropriate. Thank you.

Dr. DONOHUE. The question and the concern about external users not being involved in our integrated product teams. As I stated in my comments, I believe that this is a vital ingredient of our integrated product teams, and we are doing, I believe, the maximum that the law allows us to do.

And we're using approved governmental advisory boards to perform this function. And they can therefore represent a broad range of industry, and our customers. The RTCA Committee, and our Research and Development Oversight Committee are two approved committees that allow us to have this type of interchange of information. We're making maximum use of those forums.

The integrated product teams for security and for safety have not been set up because of the nature of the product that comes from that research. Those tend to go towards regulatory functions, and we have our regulators very much involved in that research activity, but we don't develop products per se in that area. And so it's somewhat different, and we're trying to adopt a slightly different structure. All pegs don't fit in the same shape holes. So that's what we're doing there.

In the way of oversight, we have set up special oversight agencies within my organization that are independent of the integrated product teams themselves to provide both an architectural structure, provide continuity and interface requirements, and time management and schedule, and cost management.

And all of the questions that were brought up earlier about the management tools, part charting, critical path analysis, et cetera, we are making maximum use of both internally and using our support contractors, in this case, TRW, as our prime support contractor to give us very close real-time tracking on schedule performance and cost.

Procurement reform. I'd like to say a few words about that. Much has been said; much has been done by the Congress in the last couple of years to try to implement procurement reform. That is an area that is extremely complex and difficult, not only to do, but also in some sense to understand. There is not just the federal acquisition regulations, which provide some—actually provides a lot of good guidance in many ways, which should just be good business practice. But there are some aspects of that that turn out to become very time-consuming and very costly.

One of the problems is the automatic appeal process that you have for government contracts. And almost every contract that we sign goes into a protest which can lead to months, to years of delay, and also leads to an extremely risk-averse acquisition staff, because they recognize that they're going to be defending every decision, basically, in the courts.

We also have the Competition in Contracting Act, and the Brooks Amendment, which requires us in the Competition in Contracting Act, to try to find a level playing field to encourage maximum competition. It does not recognize the realities of the marketplace, that there are many people who are much more qualified to do work than others, and that if we could only go to much more limited competition to the people who have already demonstrated expertise as opposed to trying to always level the playing field and giving everyone an opportunity, not only to compete, but also an opportunity to protest if they don't win the competition—this adds a lot of cost and time to the procurement process.

The Brooks Amendment, it makes us go to GSA for any automatic computer processing equipment. In today's world, virtually everything we buy has got a computer in it in one way or another. And therefore, virtually all of our development must go through GSA.

In areas where we have the technical expertise which is an extremely complex system, and then we work through a process that is geared much more to a business acquisition sort of oversight, which would be inappropriate for the highly integrated technical system in which we are working.

These are just a few comments on a very complicated procurement process. It's difficult in law to change all these things. I know that there are committees looking at this. We are providing all the information we can to Congress to help them understand exactly what are the problems? What leads to time and cost delays? And we are collecting specific data on that.

In the area of personnel reform, the ability to attract competent technical people into government service and retain them is very difficult today. I began my career working for NASA, and then for the Navy and research lab in my post-doc and for a number of years after that.

And after 11 years in government service, I left the government to go into the private sector because of what I felt was an inability to do high-technology work myself, and in a number of—and also a growing unattractiveness of the fringe benefit and salary compared to what I could get in the private sector.

And I spent the next 15 years of my life in the private sector doing very satisfying high-technology work.

That is not to say that there are not good people with good technical skills in the government. But you need a person who has got also quite a dedication to public service to go to the public sector to work. And we have some of those.

But we also have a staff who have not been encouraged to remain current in their skills, and we have a cadre of some very capable technical people that I have observed since I've come to the FAA.

But it is not large enough, and many of the people who are very dedicated have not been able to stay technically current by going back to school, getting masters degrees, taking refresher courses, because that is something that the culture has not encouraged, nor the budgets have allowed.

We do depend very heavily on our support contracting staff. That is a requirement, as we are trying to downsize the federal government, and we have a massive system that we are doing engineering and development of. We are in fact going through a 12 percent required reduction in staff, which limits my ability to hire people with new technical skills.

And it also requires me to work with contractors to do much of the detailed technical work. This is just a fact of life in working for the federal government. So we do the best we can.

Many of our technical people would like to do more technical work themselves. The sheer magnitude of the amount of work that we're trying to do precludes our ability to do that.

I could go on and on, but let me turn it back to you, Madam Chairman.

Mrs. MORELLA. Thank you, Dr. Donohue. That was very helpful.

I was going to ask you about the downsizing, what the effect would be. I wondered with a 12-percent reduction in staff, that you say you're trying to work out now, the difficulty to retain the good people who would also appreciate being moved ahead in terms of educational expertise.

Do you find that you are contracting out merely to reduce the number of people on your staff, as is asked for in the Reinvent Government Number 2 and the new Congress?

I guess that's a pretty direct question. But do you sometimes find that you have the expertise internally, but you are contracting out because this is the way to handle the numbers?

Dr. DONOHUE. No, I don't think we're doing anything as simple as that. It's a very complex issue. We contract out for a wide range of reasons.

Sometimes we contract out because we don't have the specific expertise that we need, and we can't hire them into the government because of hiring freezes of staff limitations. Sometimes we contract out because of just the magnitude of the amount of work that needs to be done, and we don't have the size of staff to do it.

I am now trying to bring in people under the Intergovernmental Personnel Act which I can bring in from certain universities and federally-funded research and development centers at the senior level, because we can't pay the salary levels that are required to get the very high expertise and experience that we need in some areas.

Software engineering is one of the areas that we have a lack of technical expertise within the FAA. We have a few senior people. Dr. Zellweger has his Ph.D. from Harvard in Computer Science. But the magnitude of the software development that we're doing, and the rapidly changing field of software engineering, requires us to try to have the best and brightest we can. So I'm bringing people in to bring that expertise.

So it is really a very complex set of reasons why we contract out, and not just for the downsizing. But that certainly is forcing us to rely even more heavily on our contractors.

Mrs. MORELLA. More heavily on it, right.

What about morale? Is that in question now a little bit more because of the current climate? You know, they are civil servants. Do people feel demoralized, or do they feel that they've just got to produce more? I mean, is there an atmosphere that you sense?

Dr. DONOHUE. Yes. I would say there's a certain sense of demoralization. There has been a lot of government bashing that has gone on for a long time. In fact, almost my entire professional career, in and out of the government, I have seen a growing tendency to criticize the people and the processes in the government.

Much of that criticism if warranted, but much of it also is not warranted. I would say the dedication of the staff, I have found as I came back in, especially at the FAA, of all the places that I have worked in the federal government in the past—NASA, the Navy, and at DARPA, these are as hard working a people as I've ever found, and as dedicated.

But the magnitude and the complexity of their job is probably also one of the most complex systems that I've ever engaged.

Only a few companies in the telecommunications world or in a few activities in the Defense Department have dealt with the magnitude and the sophistication of the technical problems that we're working on.

Mrs. MORELLA. I think we tend to sometimes forget how important the public-spirited people who are our civil servants, their connection with our safety and welfare.

Well, I want to ask some questions in a bit. But I wanted to give other members of the Committee an opportunity to do so. So I'd like to ask Mr. Tanner if he would like to ask any questions.

Mr. TANNER. Thank you very much. I just have a couple of observations. I'd like to get your comment.

I thought your testimony was very insightful, and I want to thank you for being here.

The criticism seems to be one about management and implementation of technologies, as much as anything, from the previous panel.

On page 5 of your testimony, you alluded to a business plan. In that regard, I'd like for you to comment on what's in the plan so we can answer for ourselves two questions. One, what kind of criteria have you developed to determine if your management changes will be effective; and two, what criteria would you recommend that we use to evaluate FAA's performance within that regard?

I would like to make this a red-letter day, and so we go from here and see where we can improve and what yardsticks we use to measure that improvement.

Thank you.

Dr. DONOHUE. Yes, we do have a business plan. I think David Hinson, who brought me into the FAA, came with a broad business background, and he is encouraging us to run the FAA much more like a business, which I am completely in agreement with.

As you know, there are six lines of business within the FAA. The research, system development, acquisition is my line of business, and so I have prepared a sub-plan for the research and development part of that.

We're looking at both short-term, medium, and long-term objectives, based upon our strategic plan. Our strategic plan is emphasizing the increase of the safety, the capacity, and the productivity of the system.

Those are our three primary goals.

We are developing a whole series of metrics to measure our process along that. Much of them are not only process-oriented, but end product-oriented. We're holding our teams accountable, not just for following a process, but for actually delivering product out the door. So those milestones are all being baselined, and budgets and schedules are being tracked.

And we're in the process of going through a great simplification of our procurement policy to the maximum extent that the law and good business practice allows.

I believe that Congress should hold us accountable for achieving the goals set forward in that business plan, which is in the process of being reviewed internally, and will be published. We're trying to make sure that our customers' needs are taken into account. And so we're having meetings with our customers to make sure that we've got the right thrusts and goals, and that we're making the right type of strategic investments for our capital investment plan, which is the area—research and capital investment are my particular responsibilities.

So I believe that we do all stand to be held accountable for what we're stating in this business plan.

Mr. TANNER. We'll look forward to seeing that, and thank you very much.

Mrs. MORELLA. Thank you, Mr. Tanner.

I'd like to now turn the questioning over to Mrs. Myrick. I know she's on a tight time frame. I also wanted to point out that she represents Charlotte, North Carolina, and I know has some specific questions.

Mrs. Myrick.

Mrs. MYRICK. Thank you, Madam Chair.

One of the members of the previous panel said that he was comparing the progress of the FAA like a trip from New York to Los Angeles, and maybe you were in Cleveland or Indiana by now. And I just wanted to say, you sure haven't come to North Carolina. That's really what I wanted to ask you a couple of questions about.

You probably are aware that back in July of '94 there was a major crash of a USAir plane in Charlotte right at the airport. And the National Transportation Safety Board issued their findings last month, and said that it was due to pilot error, as well as lack of air traffic control procedures and wind shear.

And Charlotte had been on the list to receive doppler radar back in 1991. We have been told we were going to get it, and then it was going to be installed in 1993. And of course, we still don't have it.

Naturally, the concern of the people in our area was, if it had been in place, this wouldn't have happened because it was definitely wind shear.

So my questions really are to see if you can give us some insight on what is going on in that particular area, and maybe help us with that at some point.

There has been a major problem because it's been five years since the FAA knew that you were going to need the land. And they still have not acquired the land. And that seems a little hard to understand. I know that they were negotiating with one landowner, but there's a lot of land around the airport, and there are some specific areas where it could go. And nothing has moved off that one spot.

And so, at this point, it's my understanding they still have not done that. I don't know if you're aware of this situation and can respond to that?

Dr. DONOHUE. Yes, I can.

Let me say a few words about the terminal doppler weather radar. Throughout my professional career, I have spent a lot of time working in the Defense Department on very sophisticated radar development.

As I became aware over the last nine months of the TDWR development, I was extremely impressed with what the FAA, NOAA, and the University of Boulder, University of Chicago, and MIT Lincoln Labs did to develop that radar.

I mean, if you think about it, it is trying to measure a clear air phenomenon. As an expert at Lincoln Labs told me, "We're trying to measure clutter in clutter." Initially they did not think it was something that was possible to do.

So this is a very significant technological achievement.

In the process of trying to meet the time lines for that development, they encountered going into the production process, difficulties. It's a one-of-a-kind radar. And I believe we have now—only 47 of these radar will ever be developed. If you think about the cars that you buy, probably 200 cars are built only for testing, let alone the million cars that go into production.

So we are dealing with a law of small numbers, and that's just part of what we do in this business.

That radar now, I believe, is working very well. There are certain site adaptations that must be made at each site, and that to some extent slows down the installation team. But we are proceeding now, I think, at a very rapid rate. Radars have been produced.

But this radar offers us some unusual problems that our acquisition teams have not confronted as much in the past. This radar has to go off the airport. Most of the radars that we've put, we don't have land acquisition problems because they go right on the airport itself.

This one, because it's trying to look at weather over the airport, has to sit off and look back. This has provided us with acceptance by the community—more problems with getting the environmental acceptability solution. Some of these, we have identified sites and put in quite rapidly because there wasn't a community concern. In some areas, we have had community concerns.

And quite frankly, this is the area where the integrated product team, I think, takes a better approach of making sure that the developers are working with the people in the regions for land acquisition where that's required. We could have done a better job.

We are now doing a much better job at that. We have been very hesitant to use condemnation as a solution to this problem, because in some places it looks like that was our only alternative. And we're now actually prepared to condemn land in certain areas if that's what we have to do to provide aviation flight safety.

In your particular case, the land has been acquired. Ground has been broken. We are committed to have that radar commissioned before the end of this calendar year. And my understanding is, we are on track.

Mrs. MYRICK. We are on track?

Dr. DONOHUE. That is my understanding.

Mrs. MORELLA. Would the gentlewoman yield for a moment?

Mrs. MYRICK. Sure.

Mrs. MORELLA. How many sites currently have that radar? You said 47 are planned.

Dr. DONOHUE. I believe about nine.[1] I can get the exact numbers for you. But I think nine have been installed. Three have been commissioned. And the rest are in the process of going in, because there are sites that have to be prepared, concrete footings put down, et cetera. So we are going through a waterfall based upon the people.

Raytheon is our contractor. They have responsibilities of doing these, and they have a certain size staff. And so we're waterfalling these through.

Mrs. MORELLA. So you still have a long way to go. That's what I wanted to point out.

Dr. DONOHUE. Oh, we do.

Mrs. MORELLA. When did you discover that they had to be offsite?

Dr. DONOHUE. Oh, we've always known that they had to be offsite.

Mrs. MORELLA. You've always known that?

Dr. DONOHUE. Yes.

Mrs. MORELLA. And yet no preparations had been made?

Dr. DONOHUE. No, no. I wouldn't say that no preparations were made. I'm saying all of these sites have to go through detailed calculations. We have to do specific simulations of each site to do clutter maps to identify what sites are acceptable from a visibility standpoint and radar interactions.

Those are all being done, but they have to be also scheduled, because there's a certain technical team that has to do each analysis, and it takes time to physically analyze each site.

You have to collect all the data. You have to do the simulations. You have to look at alternate sites. Then you have to work with each region to identify the ability to acquire that site. Then you have to go into negotiations with the landowners for each one of those sites. Some of those go quickly, some don't.

Then we have to physically do the civil engineering at each one of those sites. And because of our funding that's in the program, we can't do all of them in parallel, because otherwise we'd have to build a very large number of parallel teams to do each one of these installations, and we don't. So we have a certain trained group of people who can handle only a few sites at a time. And it physically takes time to go to all 47 sites.

Mrs. MORELLA. I yield back. Thank you.

Mrs. MYRICK. That's fine.

Do you feel you're moving along in that process now? Because in our case it's like five years to go through that process, which seems a little long, even with all the particulars that you mentioned. Do you feel that that's moving faster now?

Dr. DONOHUE. I believe it is, yes, it is moving much faster.

Mrs. MYRICK. Well, the other question I had is something that really dumfounded me when I learned it, because one of the problems in this crash was that the information, the weather information, was not relayed to the pilots. And I was told—and if this is incorrect, please correct me. But I was told that the air traffic controllers are not required to report weather information to the pilots.

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[1] After the hearing, FAA determined that the number of TDWRs installed was fourteen, not nine.

They didn't tell them the following facts. The storm was directly over the airport, and that the conditions had already closed the runway ramps. There were two planes already holding because of storm conditions. And they didn't tell them that they actually had seen lightning over the runways. And so none of this information was relayed to the pilots as they were coming in.

Why is that not required that they tell them when they definitely know specific facts?

Dr. DONOHUE. This could be a very long discussion.

First of all, that is into an area of operations which is not my specific responsibility at the FAA. But I will tell you, I'm also a pilot, and land at airports and talk to air traffic control myself.

Speaking for myself, the FAA is confronted with a very difficult problem in some ways. The Chicago protocols, which are basically the international rules by which air traffic operates, require air traffic organizations to provide separation of aircraft from other aircraft, and from the ground.

Separation from weather is something that the air traffic control systems try to do to the best that they can. But basically, the law states that the pilot in command ultimately has the responsibility of the safety of that aircraft. And I as a pilot have that safety. Of course, I would like to get as much advice as I can get.

Sometimes we get advice, as pilots, we don't really understand what it means. And I don't want to make any comments about this particular incident for a number of reasons. First of all, I don't think I'm that knowledgeable about the details of the findings or of the study.

But this is an area where the technology is now advancing to the point where we have capabilities to provide information to pilots and to controllers that we have never provided before. And the ability to do more than what a pilot can see with his eyes is something that is probably requiring us to rethink what the future responsibilities of air traffic control should be.

The terminal doppler weather radar sees things with microwave energy and a very elaborate signal processing that cannot be seen with the naked eye. And so just saying that the pilot in command has the ultimate responsibility to make decisions, in this type of environment, is probably something that in the future we're going to have to rethink totally what our responsibilities are as we get this technology.

And we're in the process internally of going through those kinds of discussions and trying to understand how to train the controllers to new sets of responsibilities, with equipment that many of them, quite frankly, don't understand how it works, and are not sure whether they should have confidence in.

Mrs. MYRICK. Well, I hope you can overcome that for the sake of all the flying public today.

Just one more question, relative to our particular situation.

Do you know what the status is of the back-up power facilities and the antenna motor problems that they were having? Do you know if any of that's been worked out?

Dr. DONOHUE. We're working all of those things. The power system integration has been one of our problems with TDWR and a few other radars, and I think we're getting those things into better shape.

Mrs. MYRICK. Well, from the sounds of what we've heard this morning, you've got a big job. I wish you well.

Dr. DONOHUE. Thank you.

Mrs. MORELLA. Thank you, Mrs. Myrick.

I think we probably have time for a few more questions. So let me turn to Tiahrt. I think you were here next.

Mr. TIAHRT. I'll try to be brief. First of all, as I went through the phases of the program, we're somewhere in the phase, you know, where we're looking for the guilty and we're going to punish the innocent. I know you haven't been there very long, but you've got a good background, I think, to understand good management techniques. I hope that we can get into—personally I'd like to see some things.

But I want to quote from this article out here, just briefly, where Mr. Delbalzo said, "All of these problems"—referring to these management problems and other problems the FAA is experiencing—"could be addressed, and many solved with a concerted legislative effort by Congress."

I want you to know that we are open to suggestions to try to implement a smoother procurement process. I think a lot of programs are like my golf game. The drive doesn't matter, it's the recovery shot that's important. And I think we may be in the recovery shot phase on some of these procurements.

Our staff asked for a copy or an example of a cost and schedule control system. And maybe that was the wrong question, because what they received is something dated June 1987 which goes back to C-squared reporting. And I know that we're not living under those terms now. A lot of us lived through that pain a long time ago, and know how difficult it was to live with.

But I think from my own—I don't know how many major procurements you have going on. But I assume AAS is probably one of them. I would like to know, do you have a master schedule from one of your major procurements that I could see, physically put my hands on, and so that I could look down there and say that, if you have to have something done by May 31st—or excuse me, June 1st, then I could say, "Okay, it is done." I can call you up and say, "Is this milestone completed?"

I'd like to look at one of your master schedules to see what management techniques are used just for a familiarization process.

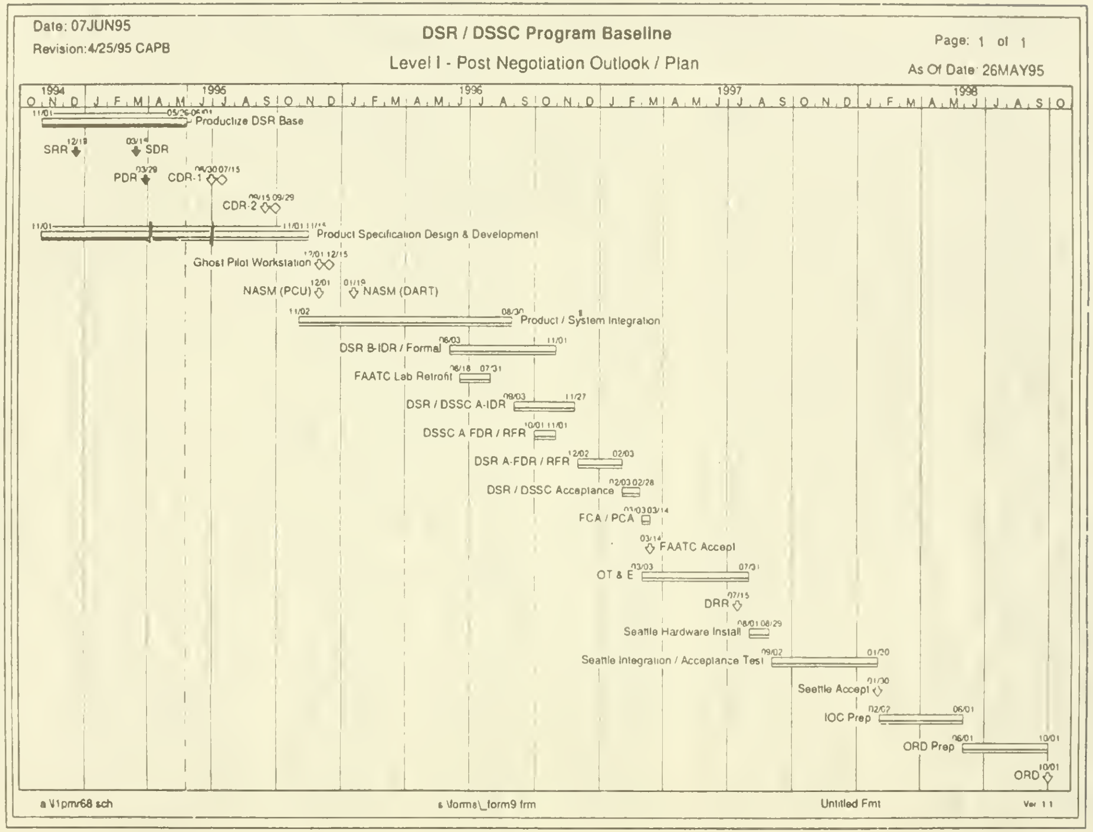
Do you have other educational efforts that you have as far as bringing people up to speed in good project management techniques or bringing them up to date on technical advancements?

And I wanted to ask one last question. I'll give you all these and then you can go on a little bit. But IPT development, I know you mentioned you used IPTs, integrated product teams. I think that they would be effective during the specification, writing, during your design phase, during the fabrication phase, during the installation phase, as well as the testing phase.

And if there are some things that restrict you from bringing in people in the process, I would like to see that, some way that we could change that so you can involve the people, users as well as contractors in that method.

Dr. DONOHUE. Let me address several of these. First of all, we will get you a copy of a detailed schedule. Let me give you the one for our display system replacement, which is one of the major parts of our advanced automation system. And so I'll take an action item to get that to you.

[The information follows:]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Ghost Pilot Workstation 12/01 12/15
NASM (PCU) 12/01
01/19 NASM (DART)
11/02 08/30 Product / System Integration
DSR B-IDR / Formal 06/03 11/01
FAATC Lab Retrofit 06/18 07/31
DSR / DSSC A-IDR 08/03 11/27
DSSC A FDR / RFR 10/01 11/01
DSR A-FDR / RFR 12/02 02/03
DSR / DSSC Acceptance 02/03 02/28
FCA / PCA 03/03 03/14
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OT & E 03/03 07/31
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List of Acronyms Used in DSR/DSSC Program Baseline

Note: The acronyms are listed in the order they appear in the Program Baseline.

SRR	System Requirements Review
SDR	System Design Review
PDR	Preliminary Design Review
CDR	Critical Design Review
NASM (PCU)	NAS (National Airspace System) Modifications for ISSS (Initial Sector Suite System)/(Printer Control Unit)
NASM (DART)	NAS Modifications for ISSS (Data Analysis and Reduction Tool)
DSR B-IDR	Display System Replacement B-Level Specification-Informal Dry Run
FAATC	FAA Technical Center
DSR/DSSC A-IDR	Display System Replacement/ DSR System Support Complex A-Level Specification-Informal Dry Run
DSSC A-FDR/RFR	DSR System Support Complex A-Level Specification-Formal Dry Run/Run for Record
DSR A-FDR/RFR	Display System Replacement A-Level Specification-Formal Dry Run/Run for Record
DSR/DSSC	Display System Replacement/ DSR System Support Complex
FCA/PCA	Functional Configuration Audit/ Physical Configuration Audit
OT&E	Operational Tests and Evaluations
DRR	Deployment Readiness Review
IOC	Initial Operating Capability
ORD	Operational Readiness Demonstration

Dr. DONOHUE. That is a very detailed schedule, down to daily accomplishments by the contractors, Loral Corporation, which we're tracking.

Secondly, in program management training, we have instituted a program at our Center for Management Development in Florida for training the principals of integrated product teams in management techniques, in communication techniques, in scheduling techniques. And we have already had, I think, three classes through that. We plan on having all of our staff within the next year or year and a half go through specific management training to try to get this cross-cultural team effort working together.

This is a big cultural change for the FAA. I will tell you that the research shows that it takes time for these cultural changes to sink in. You can give people the books. You can send them to the schools. But basically, it takes about 18 months before most people really start working in a more smooth fashion.

And most industry will say that it takes from four to five years before the full cultural change is implemented and you're getting the higher productivity that you should get from using this management technique.

Mr. TIAHRT. In closing, I just want to say that in IPTs, integrated product teams, the quickest way to destroy them is give them responsibility, let them come up with a decision, and then override it.

Dr. DONOHUE. That's right.

Mr. TIAHRT. And if you don't give them confidence in the system, the system won't work.

So you're right. It is a cultural change. It does take a long period of time. But I would like to caution you—and you've probably seen this yourself—let the system work and trust the system. Thank you.

Dr. DONOHUE. That is exactly right.

Also, in the technical training we're doing the best we can given our constrained budgets. And we're doing some internal training as part of that program.

The users are very much involved, AOPA and ATA especially representing both private pilots as well as the large commercial airlines are involved in many, many of our meetings. And we're giving them great detail, more so than they've ever had before with what we're doing and integral progress that we're making along those lines.

Mr. TIAHRT. Those are the right players.

Thank you, Madam Chairman.

Mrs. MORELLA. Thank you, Mr. Tiahrt.

We're going to go and vote now, as you can see. If you could wait for a little bit, we'll come back for our last round of questions. Thanks.

[Off the record.]

Mrs. MORELLA. Thank you for waiting around after our vote, which is the custom around here to vote, come back, and vote, and come back. But I think this hearing has gone exceedingly well, also within the time period that we had sort of allocated to it.

I would like now to continue with—Mr. Gutknecht had some other questions he wanted to ask.

Mr. GUTKNECHT. Thank you, Madam Chair.

Dr. Donohue, our committee staff—and let me just say parenthetically that, as a new member of this Congress and this committee, I think that we—my impression has been that Congress over the years has fallen short on its oversight responsibilities. I understand that you've only been on the job for seven months.

But I do have some fairly serious questions and rather troubling questions, because back in—I understand back in the fall the committee staff of this subcommittee made several requests for information from your office, and it wasn't until March 11th of this year, after the request had been made in writing, that they got the response that they were looking for.

I mentioned earlier, too, that I attended a staff briefing earlier this spring at which we were told that the advanced automation system was about 85 percent complete.

On March 30th at a meeting in your office, our staff requested, among other items, a one- or two-page summary depicting the status of AAS and other components of the National Air System. After waiting another six weeks, on May 9th, we finally were given the material. And I think it's going to be passed out now.

This material indicates, among other things, that 82 of the 84 original National Air Space projects are either implemented or completed. Is that correct?

Dr. DONOHUE. Yes. I mean, like all statistics, statistics can be quite misleading, and one has to ask both how a question is asked and how it's answered. And I did not personally answer these questions. But let me first of all look into the dates. And I am concerned if we have not been forthcoming with information. We will certainly—I'll try to find out how we can do better in the future.

But if you just look at the number of projects, I think the statistics of 85 percent and 82 out of 85 are about right. What that doesn't—that looks at number. If you asked the question about dollar, if you looked at a dollar-weighted percentage, you would see that we're much less successful on a percentage basis because two of the projects that are not completed are in the AAS, the advanced automation system.

So projects like radars and ASDE–3s and many of the communications systems and part of the system have been in fact completed. Some people don't' appreciate that.

But on the other hand, some of the large dollar aspects where we really got into trouble, we're very far behind schedule.

Mr. GUTKNECHT. Well, I think that's one of our concerns, is that some—maybe we didn't ask the right questions. But the answers we got tended to make it sound like we're much further down the road than we really are.

Dr. DONOHUE. That's no excuse for us, though. We should answer the right question whether we're asked the right question or not. And so I apologize, and we'll try to make sure that henceforth, we give the committee staff as much information as we possibly can. We have nothing that we're trying to hide.

Mr. GUTKNECHT. Well, the speaker carries around, as you know—and has probably been discussed already this morning—these vacuum tubes, which is one of the things that concerned me in my original tour of an FAA facility in Farmington, Minnesota.

The display system replacement, the center mainframe replacement and tower automation platforms, in reality the sole survivors of the $6 billion AAS has spent so far will not be fully operational—am I correct—for all FAA en route centers during this century?

Dr. DONOHUE. I don't remember all the exact details of the waterfall. What we call a waterfall, whereas we start implementation of the installation.

Our plan is to start installation one center per month. And so it takes us 20 months to start the installation for each of our 20 centers. It takes a year to do the installation, up through certification for each center, because of the magnitude of the installation process.

So there, you can figure 20 sites. Obviously it's going to take us over two years, two and a half years basically, almost three years before we've finished installation at all of the 20 sites. Our anticipation, I believe, is to start around 1998.

So yes, some of those sites will be fully operational before the turn of the century. But the ones who are on the tail end of that installation schedule won't become fully operational until after the turn of the century.

Mr. GUTKNECHT. So just for the record, though, what we were told earlier is not completely correct, and that I think one of the things that was said, that 82 of the 84 projects implemented or completed really is not an accurate description of where we stand?

Dr. DONOHUE. I think it could be a misleading description of where we stand, certainly. We should not try to hide the fact that we've got a significant amount of work underway.

I'd like to comment to some earlier discussion of the AAS. This was not on my watch, and so in some sense probably I don't have to say anything at all. But I have spent some time trying to look back in the history of that program, to understand, what were the problems? How did we go so far afield?

And I think it was a whole series of things. It was no one thing. Partly, I believe that when the FAA first thought of the NAS, the new National Air Space system, and the advanced automation system, it was an order of magnitude larger and more complex than anything they had done before.

And in fact, only a few parts of the Defense Department and a few telecommunication companies had ever successfully done something of that magnitude.

They went to two very good contractors, Hughes and IBM. The initial estimates from Hughes and IBM were that it would take between $7 to $8 billion to do the job. That was far beyond what the FAA conceived. And they were thinking closer to $3.5 billion.

There was a combination of wishing it would be less, and contractors who then came back and said, "If $3.5 billion is what you've got in mind, we can do it for that."

Then there was a whole series, I think, of just lack of sophistication on both sides of this. And so there were a lot of reasons—very optimistic system.

We are now much wiser and much smarter in building these sorts of systems. And I believe we now have the processes in place to be successful.

Mr. GUTKNECHT. Well, Madam Chair and Dr. Donohue, we're older and wiser. But how much have we spent on this education? I think one of the questions we have is that, is it true we've sunk $2.3 billion into the system so far? If we were to stop today, how much of that money would be lost?

Dr. DONOHUE. I don't know the exact number. That's about right, and we can get you the exact number.

One of the reasons that we've spent the last six months or so working very closely with Loral, formerly IBM Federal Systems, is to try to make sure we get the maximum utilization of the sunk cost.

Obviously, from a pure economic analysis standpoint, one would not want to use sunk costs as a decision on where you go in the future. But we do appreciate that we have put a significant amount of money in there, and we wanted to make sure we recouped as much of that investment as was practical and possible.

I'd say roughly two-thirds of the software for the DSR system is recoupable, and we have in our current plan—we'll be using that code. And we've spent a lot of time cleaning that up to make a useful code.

There is about a third or so of the code that remains to be written, which is why we have another year or so of development that has to be finished before we can start going into testing, and then into installation.

Also, on our TCCC, the Tower Computer Control Complex, we found that the investment there was completely usable. And we're proceeding with full development of that system. And so there was no loss of effort on that particular part of the program.

In some areas, for our terminal, what we've found is that we felt that, although IBM Federal Systems had done some good work there, there was a significant amount of commercial off-the-shelf that we felt was available to do that particular job, and that recompeting that and using the full market pressures of a competition would give the government the best buy.

Mr. GUTKNECHT. What is your current estimate to fully complete the scaled-back version of AAS, including the sunk costs?

Dr. DONOHUE. You're asking for dollar costs?

Mr. GUTKNECHT. Yes.

Dr. DONOHUE. I think our current estimate is $5.9 billion, which has been stable for about the last year now. Ever since David Hinson first started really looking into this and the recovery team went through and tried to do a cost estimate, that is a number that we have been holding ourselves accountable to.

Mr. GUTKNECHT. When you look forward at the future costs, how much of that do you think—what percentage or what total dollar amount is going to go towards development and testing?

Dr. DONOHUE. That's a complex question. We have many systems in there. I could get that number for you. Why don't you let me provide that to you after this hearing? I want to give you a good number.

Mr. GUTKNECHT. And let me just explain. One of the concerns we have, at least from the perspective of this subcommittee, is that there seems to be some confusion of what's coming out of your R&D

budget and what's coming out of F&E. It makes it difficult, at least for us, to determine what's going to what.

And that's one of the issues that we really need to get at.

Dr. DONOHUE. I can clarify that point. All of the advanced automation system work is coming out of F&E, not R&D budget. We are doing some work which is an augmentation, it will be a follow-on once we have the computer hardware and the basic software, things we call ERA for advanced automation software logic. That is being conducted in research right now, and is transitioning into our F&E budget.

It was observed earlier this morning that we do use a part of our F&E account for research type of activity. So it's not just our RE&D account. There's a reason for that, very much like the Defense Department has what they call 6.1, 6.2, 6.3 research, basic research, advanced—I'm sorry—forget this—exploratory development and then advanced development, which was 6.3.

In 6.3, they had 6.3a and 6.3b. And the reason they had that distinction is because, as you get into bigger and bigger prototypes, the type of money that is typically allocated for a research account is not adequate to just do the development of the testing.

Since we don't have that DOD budget structure, what we do is tend to use our facility and equipment account as we get to the larger-scale demonstrations and evaluations, which we just don't have adequate funding to do.

It's actually part of a migration. So there's a continuum of activity in research and development that goes from the basic ideas and relatively small-scale—there are experiments or calculations—growing in size and complexity as you go through experimental prototypes to advanced prototypes to preproduction prototypes to full-scale testing.

And so there's always going to be an artificial line somewhere in there. And that's between the two budget categories.

Mr. GUTKNECHT. Finally, Madam Chair—and I do have some other questions, and we've got other meetings, I have to go to, at least. But ultimately I guess the final question that I want to ask now, and I would like to submit some other questions perhaps in writing.

Mrs. MORELLA. I was just going to suggest that you could also submit questions in writing, too.

Mr. GUTKNECHT. But I guess the final question for this hearing that I would have is, are you going to be submitting some legislative recommendations for changes in the law, whether they be relative to procurement reform or other things that you'd like to see done that could make this task a little easier?

Dr. DONOHUE. Well, the Administration has a proposal before the House for forming the Air Traffic Control Corporation. I think the belief is that that goes to the heart of trying to address our procurement, personnel, and access to capital problems that air traffic has for doing a massive modernization. So that legislation is pending.

Mr. GUTKNECHT. Well, one final question, then. Do you support that concept?

Dr. DONOHUE. I personally? Yes, I support the concept.

Mr. GUTKNECHT. Thank you.

Mrs. MORELLA. Thank you, Mr. Gutknecht.

I wanted to just pick up on the budgetary point of what this committee is kind of getting at. And that is sort of truth in budgeting. I mean, when you've got monies in R&D and, you know, you've got other monies in the F&E accounts and whatever, are you going to remedy that in the near future?

Dr. DONOHUE. Well, we do. I think from a truth in budgeting standpoint, in our F&E account, we have what we call, I guess, part one money which is activity one money, which we do identify for the appropriations and the authorization committees to look at, that say that these are what we call more basic or more exploratory type of activities as opposed to, as we break that account into other parts, we're going closer to the full-scale development.

Mrs. MORELLA. So do you plan to modify your out-year budget request to reflect the actual R&D budget, like in FY97?

Dr. DONOHUE. First of all, I think that we will continue to show in our F&E account, those type of activity one, as we have been doing. But we're also—I would say that, as I came here, we didn't necessary have the best division in what we funded under RE&D and what we funded in F&E.

And we told everybody exactly what we were funding and what we were doing. So I think we've been very open in that respect. But within our internal competition for funds process, because of the urgency for getting modern equipment into the field, some of the activities that I would say were of more of a research nature that were in the F&E account tend to get less emphasis than they should get.

We're in the process of what I'd say rationalizing our budgets so that we can try to make sure that the things that are really vital, of a research nature, long-term research nature, don't get funded in our F&E account. They get funded in our research account where we have appropriate oversight in the internal budgetary process to give it the adequate weight that it is due.

On the other hand, we were doing some things in the R&D account which I would consider to be advanced prototyping. And they would be more appropriately being done in our F&E account.

So there is going to be some movement of activities between those accounts over the next year, as my staff here and I do a detailed line item by line item review.

Mrs. MORELLA. That will give the clarification.

I wanted to point out something in the GAO report that I was reading. It says that, "FAA maintains a service difficult report database that airlines, FAA inspectors," et cetera, "engineers are supposed to use to alert them to incipient safety problems."

Now, a 1994 report by the Department of Transportation's Inspector General found continuing problems, noted that the SDR reports are incomplete, omissions of information on particular part numbers, models, manufacturers, et cetera, et cetera, concluded that FAA, I think it was, lacks the tools to properly evaluate suspected aircraft maintenance and design problems, does not have an adequate tracking and reporting mechanism to retrieve information from earlier incidents.

Would you like to respond to that?

Dr. DONOHUE. I am only personally vaguely familiar with that. I'd like to have Dr. Miller answer that question.

Dr. MILLER. I can't respond directly to the situation with respect to service difficulty reporting. But there is a significant initiative within our aircraft safety program within the research area to improve the consolidation of data on safety issues, on maintenance and malfunction reports that come from the industry, so that information can be available to our aviation inspectors coast to coast.

It includes not only the data collection, which is now in cooperation with industry, but also an analysis capability that looks for trends in the data to see if there are particular models of engines which are experiencing some particular type of difficulty, and again to provide that information throughout our inspector work force.

So in that aspect of safety data collection analysis, we're making progress.

Mrs. MORELLA. When the Inspector General looks into FAA and comes out with points that have been noted that need improvement, what is the time frame for your response to that? You do respond to each one of the times, don't you?

Dr. DONOHUE. Yes, we do.

Mrs. MORELLA. How soon? When is the next report coming out?

Dr. DONOHUE. I think it's 30-day[2] I think we have a 30-day response, initial response.

Mrs. MORELLA. Thirty day response? When's the next report coming from the IG?

Dr. DONOHUE. I think they come at irregular rates, depending upon what they're doing and when they write their report.

Mrs. MORELLA. So it isn't like twice a year they review——

Dr. DONOHUE. No. They come out as—I think as they have a finding, they come out with a draft report, and we get a chance to see that.

Mrs. MORELLA. Okay. Right, right. Well, I hope you also keep us posted on what's happening with Loral and the AAS program. I never understood why so much money could not be returned in some way in terms of some of the developments in the early stages of that program. So much was irretrievable. I remember looking into it.

Dr. DONOHUE. But a lot of it was retrievable.

Unfortunately, there is part that is not retrievable for a lot of reasons. And I'd be happy to spend time with you, if you'd like. It's a long discussion.

Mrs. MORELLA. Well, we've had some discussions with some people from your staff and Loral on what was not retrievable.

I wanted to thank you and the other witnesses for coming. I also would like to submit some questions to you for responses. I hope you know, I didn't bring up the noise abatement policy.

Dr. DONOHUE. Thank you. [Laughter.]

Mrs. MORELLA. But you know, you're welcome to respond to that at some other time if you'd like, or in writing in terms of improvements. I feel very strongly about that as an environmental concern, also as well as a safety concern.

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[2] After the hearing, FAA determined that the response time to OIG reports is 60 days, not 30 days.

I hope you know that this subcommittee cares very strongly and feels deeply about what you are doing in the hopes that you'll be able to pull together the personnel, the computer technology, the management skills that obviously have been needed through the years. And I appreciate the progress you have made.

Before I do adjourn the meeting, I wanted to give Ms. Lofgren an opportunity for a final statement.

Ms. LOFGREN. Thank you, Madam Chairwoman. And I won't unduly delay the hearing.

I did have just two questions, and it would be absolutely fine to have them answered in writing later.

One question really has to do with the question asked the previous panel, which is whether or not you have considered or would think it would be useful to contract out some portion of your management function with a management firm that would work as your partners.

And question number two has to do with the challenge to contracts mentioned in your statement. One question I have, and a process that's used in other levels of government successfully is a system where one prequalifies bidders by their expertise, and then, rather than doing a competitive bid, negotiates a price only with those who have been deemed qualified. And whether that would resolve some of the problems that you've encountered that you mentioned in your statement.

And that could also be in writing, unless you have a quick yes or no answer.

Dr. DONOHUE. I actually have quick answers to both those. First of all, we do contract out as much of the non-decision making management authority that we can. But as government officials we have certain fiduciary responsibilities that are essential governmental functions. We cannot contract those out.

And in fact, I think there was a desire at one point that Martin Marietta could do that job. And looking at them over almost a 10-year period of time, we found that they were not able to, not because I don't think Martin is a qualified contractor, and has the expertise. But they've found that they were unable to make decisions that would stick in the governmental environment.

And ultimately government officials have to make the decision. We can't give up our responsibilities there.

Secondly, I agree with you, and we're using prequalification as a technique. But you realize, even there it's a justification for less than full and open competition. And if it has computers involved, we have got to get the delegated procurement authority from GSA, and so it's not something that we can unilaterally do.

Ms. LOFGREN. I understand. But if we were to change the procurement rules of the federal government, would that work?

Dr. DONOHUE. Yes. And in fact, we are doing that right now in a pilot program under the Procurement Reform Act of last year where we have one development program and they allowed us to use prequalification on that. And we're tracking how much that's saving us in time and money, along with a number of other things that we've asked for specific relief on.

Those things are helping us quite a bit. And if we could have that institutionalized across the board, it wouldn't solve all our problems, but it would go a long way towards making things better for us.

Ms. LOFGREN. If I could just very briefly follow up on the—obviously those in government who are trusted with making the decision can't delegate the ultimate decision making authority. However, in every decision, there are a series of steps and monitorings that are basically a management function, but are not necessarily the ultimate decision making function.

And I'm wondering—perhaps what I should do is send to you some information on this that explores that model, and see what you think about it.

Dr. DONOHUE. Yes. We'd be happy to receive that, and I'm happy to respond to you.

Ms. LOFGREN. Thank you.

Mrs. MORELLA. And we'd be happy to also have a copy of that business plan that you said you're putting together. That may be a nice report card.

Dr. DONOHUE. As soon as that gets approved by the Administrator, we will so.

Mrs. MORELLA. Thank you.

The meeting is now adjourned. Thanks very much.

[At 12:19 p.m., the hearing was adjourned, subject to the call of the Chair.]

APPENDIX

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

JUN 20 1995

The Honorable Constance A. Morella
Chairwoman, Subcommittee on Technology
Committee on Science
Rayburn House Office Building, Suite 2319
Washington, DC 20515

Dear Chairwoman Morella:

I appreciated the opportunity to testify on May 16, 1995 before the Subcommittee on Technology regarding the Federal Aviation Administration's Research and Acquisition Management. I am pleased to enclose my responses to the questions for the record posed in your letter dated May 25.

Sincerely,

George L. Donohue
Associate Administrator for Research
and Acquisitions

Enclosure

RESPONSES OF FAA ASSOCIATE ADMINISTRATOR FOR RESEARCH AND ACQUISITIONS GEORGE L. DONOHUE TO QUESTIONS FOR THE RECORD

1. Question: How many of the career GM-15's/SES's that were in managerial/supervisory positions of the Advanced Automation System (AAS) are still in that program or are in similar positions at FAA today? What are their functions?

Answer:

None of the three Senior Executive Service employees who were in managerial or supervisory positions in the AAS program are in the scaled-down, restructured AAS program, which consists of the Display System Replacement (DSR) program, Tower Control Computer Complex (TCCC), and the Standard Terminal Automation Replacement System (STARS). Two of the three are still with FAA today. One is Director of Air Traffic Plans and Requirements Service in FAA headquarters, and the other is an Airways Facilities Division Manager.

Of the twelve GM-15s who were in managerial or supervisory positions in the former AAS program, only one is currently in a supervisory position in the restructured AAS program (as the Deputy Integrated Product Team Leader for Enroute Programs). Four others have non-supervisory positions in the restructured AAS programs. The rest are in other acquisition management positions within the FAA, except for three who have retired.

2. Question: How will Integrated Product Teams (IPT) be structured and managed differently from past FAA "committees" and "task forces" to provide more positive results?

Answer:

FAA's Integrated Product Teams (IPT) are structured and managed differently from any previous FAA organization. The management principles of our Integrated Product Development System -- shared accountability, incentives for teamwork, empowerment, concurrent involvement of all required functional expertise, team-based decisions, a focus on customer satisfaction, and life-cycle responsibility for products/services -- all promote better, faster decisions and more positive results.

FAA committees and task forces, unlike IPTs, do not have line management responsibility for accomplishing elements of the Agency's mission. Also, most often these other groups are formed to address short-term or ad hoc issues and problems. In contrast, IPTs have been established as mission organizations of the FAA to perform long-term business operations. Another difference is that committees and task forces usually report to an individual FAA organization, while IPTs are managed by cross-functional teams.

3. Question: Will your program managers be individually held accountable for their performance and leadership?

What contemporary acquisition management elements have been incorporated in their individual performance criteria for evaluation?

(Examples)

- a. mission analysis/operational requirements
- b. cost, schedule, performance constraints
- c. acquisition strategy
- d. design approach; commercial off-the-shelf, dual/joint use, preplanned product improvement
- e. systems engineering
- f. trade-offs
- g. configuration, interface, and risk management
- h. contracting, budgeting and funding
- i. test and evaluation
- j. productivity , reliability, maintainability, supportability, testability
- k. milestones, thresholds, baselines
- l. operational effectiveness and suitability

Answer:

I and my management team of six directors have overall responsibility for performance and leadership in Research and Acquisitions. This responsibility is spelled out clearly in each director's individual performance standards and requirements.

Similar standards for delivery of products have been developed for Integrated Product Team leaders. These standards are quite specific and include most of the acquisition management elements listed above. For example, team leaders are evaluated according to criteria that apply to meeting cost, schedule, and technical performance constraints; configuration, interface and risk management; and acquisition strategy and design approach. We are also developing measures to ensure that individual team members, not just team leaders, are held responsible for delivery of products.

Since my office provides overall program oversight for the research and acquisitions process, we display program milestones prominently in the conference room where the management team meets twice a week. Whenever a program falls behind schedule, even by as little as 30 days, the director and Integrated Product Team responsible must develop a plan to get the program back on track by the next reporting date.

4. Question: The Research, Engineering and Development (R,E&D) budget authorized by this Committee has grown from $150 million in FY 88 to $259 million in FY 95. However, the FAA funds research and development from a number of sources. For

example, in FY 95, FAA has $545 million in its Facilities & Equipment (F&E) account for engineering, development, test, and evaluation. FAA also benefits from research conducted by other Federal agencies, such as NASA and DOD.

a. How is the budgeting process at FAA structured to avoid confusion regarding the nature of the work being funded out of these respective accounts? That is, how does the FAA budgeting/accounting system accurately indicate effort that is truly *research and development* as opposed to effort focused toward the acquisition of any operationally-certified system?

b. Do you plan to modify your out-year budget requests (beginning in FY 97) to reflect your actual research and development budget?

Answer:

A large portion of FAA's R,E&D account is regulatory or procedural by nature (i.e., results in rulemaking or development of procedures and standards) and has no equipment, facilities, or structures as end products. These programs, such as research projects in aircraft safety, security technology and human factors, are always funded in the R,E&D account. The other more developmental programs, such as air traffic management technology, and communications, navigation, and surveillance initiatives, generally lead to equipment, facilities, or structures as end products; these programs migrate into the F&E account upon mitigation of risk. Such migration into the F&E account could include funding for production prototyping, full-scale development, limited production, or production.

This guidance, which the FAA will continue to follow in developing future budgets, is contained in FAA Order 2500.8A, Funding Criteria for Operations, Facilities and Equipment (F&E), and Research, Engineering and Development (R,E&D) Accounts, dated 4/9/93.

House Report 102-156 supporting the FY 92 appropriations bill directed the FAA to establish an FAA order clearly describing the criteria under which funding is to be budgeted in each of those appropriations.

5. Question: There has been a trend for the Administrator of the FAA to change about every two years. However, the Administrator is just one of the many senior executives within the agency -- many of whom are career civil servants and have been with the FAA for years.

a. When you reorganized FAA research and acquisition functions, did you assume that the Administration's proposal to create a government corporation with Air Traffic Control (ATC) would take effect?

Answer:

When we reorganized Research & Acquisitions, we designed an organization that would function well within the FAA as it currently exists or in an air traffic corporation, if legislation to create such a corporation were enacted.

b. Would you reorganize FAA research and acquisition functions the same today if ATC corporatization were not being proposed?

Answer:

Yes. I have devoted much of my career in government and the private sector to studying the best way to move technology to market. I have found that successful efforts were accomplished by small teams of highly-motivated and technically competent professionals, working closely with their customers to develop products. I am convinced that Integrated Product Teams working within the product line structure we have established is the best solution for the FAA, regardless of whether the ATC corporatization proposal is enacted.

c. How will the reorganization affect research and development activities if the ATC is not converted to a corporation?

Answer:

As described above, the reorganization will benefit FAA's research and development activities regardless of the ATC corporatization proposal.

d. Are Federal Acquisition Regulations and budgeting rules primary impediments in modernizing the ATC system? If yes, give specific examples.

Answer:

Relief from the Federal Acquisition Regulations (48 CFR Chapter 1), the Competition in Contracting Act (41 USC section 251 and following), and the Brooks Act (40 USC section 759), among other laws, would help the FAA operate more like a business, and are fundamental changes sought in the ATC corporation proposal. Under the current 12-step government acquisition process, it can take months, sometimes years, from the time customer requirements are defined to the time a contract can be awarded. This compares to a three-step process in the private sector that can be accomplished in weeks. Our vision for a re-engineered acquisition system is a process that satisfies the legitimate competitive and oversight concerns expected of government acquisition practices in a significantly shorter period.

While the FAA is taking advantage of opportunities made available under the Federal Acquisition Streamlining Act (FASA), FASA does not represent the wide-sweeping changes needed to provide relief for agencies such as the FAA, most of whose major acquisitions are far beyond the scope of FASA.

Relief from the government's budgeting rules would also assist us in operating more like a business. Multiyear budget plans, for example, would provide greater flexibility to adapt to changing needs and circumstances. This would enhance our ability to develop a revenue stream to match requirements.

> e. Do you have all the assets within the FAA to complete the modernization of the National Airspace System? If not, what additional assets are needed?

Answer:

Our FY 1996 budget request is sufficient to support our current capital investment priorities and schedules. To meet the need for technical expertise, we supplement our staff with highly-qualified contract personnel. An example of this is our recent contract with TRW to support system modernization efforts.

> f. What specific modifications to law would enhance your ability to achieve FAA research and development objectives?

Answer:

The relief that the Administration seeks in its ATC corporatization proposal -- to provide FAA the procurement, personnel and budgetary flexibility it needs -- would enhance our ability to achieve FAA's research and development objectives. This would include the flexibility to move employees when and where they are needed, and to set pay scales and incentives to hire and retain employees in high-cost areas. It also would include the kind of acquisition relief outlined in the answer to Question 5(d).

> g. What measures of success do you believe Congress should use to evaluate the effectiveness of FAA research and development initiatives in one year? Two years? Four years?

Answer:

In the short- and long-term, Congress should evaluate whether the FAA is meeting its own performance standards. Each IPT, for example, is responsible for developing metrics to measure its performance. These metrics cover everything from cost/schedule performance to cycle time and customer satisfaction. Congress, at the appropriate time, should evaluate whether we meet these standards.

In four to five years, Congress should determine whether the agency has delivered on its promise to effect the core cultural changes needed to transform the agency. The new organizational structure is in place and we are introducing the processes that go along with the new structure. Some changes will be apparent almost immediately, such as the revisions we have made to the Advanced Automation System contract to get it back on track and the changes we are making, within existing restrictions, to streamline the acquisition process. However, most organizational development experts say it takes from three to five years to change organizational behavior at its core. I have promised to stay a minimum of five years to see this through.

6. Question: To enhance Congressional oversight functions, current law imposes cost/schedule/performance reporting requirements for DOD major acquisitions programs.

a. Does the FAA have similar statutory reporting requirements to the Congress?

Answer:

Although the FAA has no statutory reporting requirements, we do have internal cost, schedule and performance measurement requirements for all acquisitions over $2 million, except for production contracts that are either firm fixed price or firm fixed price with economic adjustment.

b. How could such measures support your reorganization efforts?

Answer:

A statutory requirement to report to Congress is unnecessary to support our reorganization efforts. The FAA has found invaluable the information that is generated in response to our cost, schedule and performance measurement requirements. To assist in implementing these requirements, FAA has guidance similar to the DOD procedures on how to prepare cost and schedule status reports, cost performance reports, contract funds status reports, and contract work breakdown structure. In addition, the FAA has participated in the Performance Measures Joint Acquisition Criteria Group for several years and is drawing on the information and approaches shared there to further enhance our performance measurement structure and support our reorganization efforts.

7. Question: The Defense Acquisition Workforce Improvement Act requires formal education and selection criteria for DOD major program managers.

a. Does FAA have similar statutory education and certification criteria for its program managers?

b. Do you believe it would be advisable to institute similar criteria for FAA program managers who execute comparable budget authority?

Answer:

While the FAA does not have statutory education and certification criteria for its program managers, we do require specific education and experience in our manager selection process, such as the demonstrated ability to manage the cost, schedule and technical performance aspects of large acquisition projects. We believe it would not be advisable to institute statutory criteria since that would limit our flexibility, which is particularly important under the IPT system, to assess managerial competence.

We are taking steps to improve our program managers through a combination of external recruitment and a training regimen to develop a strong management knowledge and skill base in-house. To develop the kinds of skills needed by IPT leaders, the FAA is providing a new leadership course to all IPT leaders and managers. To date, more than 80 IPT leaders and managers have taken the course in the four sessions conducted since the course was established earlier this year. We are also updating the agency's four-week course in acquisition management skills to reflect the IPT concepts.

8. Question: Could you please provide this Subcommittee with "waterfall" charts depicting the status (from now up to the Operational Readiness Date) at each proposed site for the following projects:

a. Terminal Doppler Weather Radar (TDWR)
b. Runway incursion alert system (ASDE-3/AMASS)
c. Advanced Automation System (AAS)
    1) Peripheral Adapter Module Replacement Item (PAMRI)
    2) Display Channel Complex Rehost (DCCR)
    3) Display System Replacement (DSR)
    4) Automated Enroute Air Traffic Control (AERA)
    5) HOST/Enhanced Direct Access Radar Channel
    6) Standard Terminal Automation Replacement System (STARS)
    7) High Availability Basic Tower Control Computer Complex (HAB TCCC)
d. Air Route Surveillance Radar (ARSR-4)
e. Voice Switching and Control System (VSCS)

Answer:

We have provided "waterfall" charts on the following pages for each of the projects requested. These abbreviations have been used on the charts:

ORD means Operational Readiness Date
A means Actual ORD
N/A means "not applicable" because the site is owned by the FAA and used for training and testing.

a.) Terminal Doppler Weather Radar (TDWR)

Site Name	ORD
Houston, TX	*Jul-94 (A)*
Memphis, TN	*Dec-94 (A)*
St. Louis, MO	*Feb-95 (A)*
Kansas City, MO	Jun-95
Atlanta, GA	Jul-95
Washington National, DC	Jul-95
Denver, CO	Jul-95
Boston, MA	Jul-95
Dallas Love, TX	Jul-95
Chicago O'Hare, IL	Aug-95
New Orleans, LA	Aug-95
Pittsburgh, PA	Aug-95
Camp Springs, MD	Aug-95
Newark, NJ	Aug-95
Detroit Metro, MI	Aug-95
Houston Hobby, TX	Aug-95
Dallas/Fort Worth, TX	Aug-95
Tampa, FL	Sep-95
Dayton, OH	Oct-95
Miami, FL	Oct-95
Wichita, KS	Oct-95
Orlando, FL	Nov-95
Charlotte, NC	Nov-95
Indianapolis, IN	Dec-95
Milwaukee, WI	Jan-96
Philadelphia, PA	Feb-96
West Palm Beach, FL	Feb-96
Cleveland Hopkins, OH	Apr-96
Washington Dulles, VA	Jun-96
Columbus, OH	Jul-96
Salt Lake City, UT	Jul-96
Cincinnati, OH	Aug-96
Baltimore, MD	Sep-96
Oklahoma City, OK	Sep-96
Minneapolis, MN	Oct-96
Nashville, TN	Nov-96
Raleigh/Durham, NC	Dec-96
Tulsa, OK	Jan-97
Louisville, KY	Feb-97
Chicago Midway, IL	TBD*
Phoenix, AZ	TBD*
San Juan, PR	TBD*

Fort Lauderdale, FL	TBD*
New York City (JFK/LGA)	TBD*
Las Vegas, NV	TBD*
FAA Aero Center, OK	N/A
Oklahoma City - PSF	N/A

*"TBD" indicates that the ORD for these locations is "to be determined" due to delays encountered in siting. The radar for New York City will serve both JFK and La Guardia airports; the radar planned for La Guardia is being relocated to Las Vegas.

b.) **Runway Incursion Alert System (ASDE-3/AMASS)**

Airport Surface Detection Equipment (ASDE-3)

Site Name	ORD
Seattle, WA	*Dec-93 (A)*
Detroit Metro, MI	*Nov-94 (A)*
Cleveland Hopkins, OH	*Dec-94 (A)*
Anchorage, AK	*Dec-94 (A)*
Portland, OR	*Dec-94 (A)*
Atlanta, GA	*Jan-95 (A)*
St. Louis, MO	*Jan-95 (A)*
Boston, MA	*Jan-95 (A)*
JFK, New York	*Feb-95 (A)*
Los Angeles #2 S, CA	*Feb-95 (A)*
Minneapolis, MN	*Feb-95 (A)*
Dallas/Fort Worth, TX	*Mar-95 (A)*
Los Angeles #1 N, CA	*Apr-95 (A)*
Kansas City, MO	*May-95 (A)*
Denver #1 L, CO	*May-95 (A)*
Baltimore, MD	*May-95 (A)*
Philadelphia, PA	Aug-95
Denver #2 R, CO	Aug-95
Miami, FL	Aug-95
San Francisco, CA	Aug-95
Houston #2 R, TX	Aug-95
New Orleans, LA	Sep-95
Pittsburgh, PA	Dec-95
Memphis, TN	Dec-95
Chicago O'Hare, IL	Jan-96
Charlotte, NC	Apr-96
Raleigh, NC	Jun-96
San Diego, CA	Jun-96
Washington National, DC	Jul-96
Cincinnati Covington, OH	Sep-96
Washington Dulles, VA	Oct-96
Houston #1 L, TX	Mar-97
Orlando, FL	Mar-97
Camp Springs, MD	Sep-97
Newark, NJ	Apr-98
La Guardia, New York	Jul-98
Santa Ana, CA	Oct-99
Tampa, FL	Nov-99
FAA Aero Center, OK	N/A
FAA Technical Center, NJ	N/A

Airport Movement Area Safety System (AMASS)

Site Name	ORD
San Francisco, CA	Jan-98
Atlanta, GA	Aug-98
Boston, MA	Aug-98
Portland, OR	Sep-98
JFK, New York	Sep-98
Seattle, WA	Oct-98
Detroit Metro, MI	Oct-98
Philadelphia, PA	Nov-98
Pittsburgh, PA	Nov-98
La Guardia, New York	Dec-98
St. Louis, MO	Dec-98
Dallas/Fort Worth, TX	Jan-99
Miami, FL	Jan-99
Kansas City, MO	Feb-99
Cleveland Hopkins, OH	Feb-99
Denver #1, CO	Mar-99
Denver #2, CO	Mar-99
Houston #1, TX	Apr-99
Houston #2, TX	Apr-99
Minneapolis, MN	May-99
Anchorage, AK	May-99
Memphis, TN	May-99
Baltimore, MD	Jun-99
Chicago O'Hare, IL	Jun-99
Camp Springs, MD	Jun-99
Washington Dulles, VA	Jul-99
New Orleans, LA	Jul-99
Newark, NJ	Aug-99
Raleigh, NC	Aug-99
Charlotte, NC	Sep-99
Los Angeles #1 N, CA	Sep-99
Los Angeles #2 S, CA	Sep-99
Cincinnati Covington, OH	Oct-99
Orlando, FL	Oct-99
San Diego, CA	Nov-99
Washington National, DC	Nov-99
Santa Ana, CA	Nov-99
Tampa, FL	Dec-99
FAA Aero Center, OK	N/A
FAA Technical Center, NJ	N/A

c.) Advanced Automation System (AAS)

1) Peripheral Adapter Module Replacement Item (PAMRI)

Program complete.

2) Display Channel Complex Rehost (DCCR)

This is a development effort. No production units are currently planned.

3) Display System Replacement (DSR)

Site Name	ORD
Seattle, WA	Oct-98
Salt Lake City, UT	Dec-98
Atlanta, GA	Jan-99
Denver, CO	Feb-99
Chicago, IL	Feb-99
Fort Worth, TX	Mar-99
Washington (Leesburg, VA)	Apr-99
Houston, TX	May-99
Cleveland, OH	Jun-99
New York, NY	Jul-99
Kansas City, MO	Aug-99
Memphis, TN	Sep-99
Albuquerque, NM	Oct-99
Oakland, CA	Nov-99
Minneapolis, MN	Dec-99
Miami, FL	Jan-00
Los Angeles, CA	Feb-00
Indianapolis, IN	Mar-00
Jacksonville, FL	Apr-00
Boston, MA	Jun-00
Anchorage, AK	Jun-00

4) Automated EnRoute Air Traffic Control (AERA)

Currently in planning phase. No schedule established.

5) HOST/Enhanced Direct Access Radar Channel

Currently in planning phase. No schedule established.

6) Standard Terminal Automation Replacement System (STARS)

Currently in planning phase. First ORD scheduled for Boston Logan, MA in December 1998. Final system ORD is scheduled at a location to be determined in December 2003. Remaining systems to be procured with locations and ORDs to be established.

7) High Availability Basic Tower Control Computer Complex (HAB TCCC)

Site Name	ORD
El Paso, TX	Apr-97
Nashville, TN	Jul-97
Minneapolis, MN	Sep-97
Philadelphia, PA	Oct-97
Salt Lake City, UT	Nov-97
Fort Lauderdale, FL	Nov-97
San Diego, CA	Dec-97
St. Louis, MO	Dec-97
Chicago Midway, IL	Dec-97
San Antonio, TX	Jan-98
Miami, FL	Jan-98
Seattle, WA	Feb-98
JFK, New York	Feb-98
Chicago O'Hare, IL	Mar-98
Orange Co., CA	Mar-98
Kansas City, MO	Apr-98
Windsor Locks, CT	Apr-98
Portland, OR	Apr-98
Houston, TX	May-98
West Palm Beach, FL	May-98
Buffalo, NY	Jun-98
Boston, MA	Jun-98
Burbank, CA	Jul-98
Milwaukee, WI	Jul-98
Rochester, NY	Aug-98
Los Angeles, CA	Aug-98
Houston Hobby, TX	Sep-98
Orlando, FL	Sep-98
Newark, NJ	Oct-98
Denver, CO	Oct-98
Ontario, CA	Nov-98
New Orleans, LA	Nov-98
Indianapolis, IN	Dec-98
Oakland, CA	Dec-98
Dallas Love, TX	Jan-99
Tampa, FL	Jan-99
La Guardia, New York	Feb-99
San Francisco, CA	Feb-99
Atlanta, GA	Mar-99
Cleveland Hopkins, OH	Mar-99
Syracuse, NY	Mar-99
Anchorage, AK	Apr-99

Sacramento, CA	Apr-99
Dallas/Fort Worth, TX (3)	May-99
Birmingham, AL	May-99
Reno, NV	Jun-99
Memphis, TN	Jun-99
Port Columbus, OH	Jul-99
Albany Co., NY	Jul-99
Las Vegas, NV	Aug-99
Louisville, KY	Aug-99
Austin, TX	Sep-99
Pittsburgh, PA	Sep-99
Will Rogers OK City, OK	Oct-99
Phoenix, AZ	Oct-99
Cincinnati Covington, OH	Nov-99
Detroit Metro, MI	Nov-99
Tulsa, OK	Dec-99
Baltimore, MD	Dec-99
Tucson, AZ	Jan-00
Charlotte, NC	Feb-00
Washington Dulles, VA	Mar-00
Raleigh, NC	Apr-00
San Jose, CA	May-00
Kahului, HI	Jun-00
Albuquerque, NM	Jul-00
Washington National, DC	Aug-00
Honolulu, HI	Sep-00
San Juan, PR	Oct-00
Camp Springs, MD	Dec-00
FAA Technical Center, NJ	N/A

d.) **Air Route Surveillance Radar (ARSR-4)**

Site Name	ORD
Mt. Laguna, CA	Nov-95
Tamiami, FL	Nov-95
Empire, MI	Nov-95
Lake Charles, LA	Nov-95
Rocksprings, TX	Dec-95
King Mountain, TX	Mar-96
Nashwauk, MN	Mar-96
Makah, WA	Apr-96
Oceana, VA	Apr-96
Deming, NM	Apr-96
Cross City, FL	May-96
Watford City, ND	May-96
Jedburg, SC	Jun-96
North Truro, MA	Jun-96
Melbourne, FL	Jul-96
Finley, ND	Jul-96
Oilton, TX	Aug-96
Salem, OR	Aug-96
Bucks Harbor, ME	Sep-96
Slidell, LA	Sep-96
Gibbsboro, NJ	Oct-96
Whitehouse, FL	Oct-96
Eagle Peak, TX	Oct-96
Mount Kaala, HI	Nov-96
Caribou, ME	Dec-96
Tyndall, FL	Dec-96
Morales, TX	Jan-97
Bootlegger Ridge, MT	Jan-97
Mica Peak, WA	Feb-97
Mt. Santa Rosa, Guam	Feb-97
Mill Valley, CA	Mar-97
Riverhead, NY	Mar-97
Fort Green, FL	Apr-97
Lakeside, MT	Apr-97
Paso Robles, CA	May-97
Key West, FL	May-97
Ft. Fisher, NC	Jun-97
Utica, NY	Jun-97
Rainbow Ridge, CA	Jul-97
Ajo, AZ	Aug-97
FAA Aero Center, OK	N/A

e.) Voice Switching and Control System (VSCS)

Site Name	ORD
Seattle, WA	*Jun-95 (A)*
Salt Lake City, UT	*Jun-95 (A)*
Denver, CO	Jul-95
Atlanta, GA	Sep-95
Anchorage, AK	Oct-95
Chicago, IL	Nov-95
Fort Worth, TX	Dec-95
Washington (Leesburg, VA)	Jan-96
Houston, TX	Feb-96
Boston, MA	Mar-96
Cleveland, OH	Apr-96
New York, NY	May-96
Kansas City, MO	Jun-96
Memphis, TN	Jul-96
Albuquerque, NM	Aug-96
Oakland, CA	Sep-96
Minneapolis, MN	Oct-96
Miami, FL	Nov-96
Los Angeles, CA	Dec-96
Indianapolis, IN	Jan-97
Jacksonville, FL	Feb-97
FAA Technical Center, NJ	N/A
FAA Aero Center, OK	N/A

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STATEMENT FOR THE RECORD

of

DR. E. DAVID HINKLEY
CHAIRMAN
AEROSPACE POLICY COMMITTEE

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS-UNITED STATES ACTIVITIES

before the

SUBCOMMITTEE ON TECHNOLOGY
HOUSE COMMITTEE ON SCIENCE

FEDERAL AVIATION ADMINISTRATION
RESEARCH AND ACQUISITION MANAGEMENT

April 16, 1995

On behalf of the Institute of Electrical and Electronics Engineers United States Activities, I wish to commend the chairwoman of this committee on her leadership in the area of research and development within the Federal Aviation Administration. IEEE-USA is seriously concerned with the modernization of this nation's air traffic control system and the FAA's R&D programs supporting that goal. We recently completed a position paper on that issue whose main points are contained in this statement. For the record I would like to point out that this statement was developed by the Aerospace Policy Committee of the IEEE-USA, which I chair. It represents the considered judgement of a group of US IEEE members with expertise in the subject field.

Deregulation of the U.S. airline industry has resulted in innovations by the industry to meet the demand for more affordable air travel. The growth in air travel threatens to overwhelm the presently inadequate air traffic control system, which has not kept pace with available technology in navigation, communications, and flight surveillance.

Much of the equipment used for air traffic control today is based on fifty-year-old technology; for example, analog simplex voice links for communications and ground-based radar for surveillance, and VHF Omnidirectional Range/Distance Measuring Equipment (VOR/DME) for navigation. The lack of system automation imposes heavy workloads on human air traffic controllers and increases the risk of accidents in heavy traffic situations.

Capacity limits are being reached in both airports and airspace, with congestion delays in departure and arrival schedules becoming commonplace. Funds to upgrade the air traffic control system are available in the trust fund created to receive the tax applied to airline passenger tickets and the tax on fuel for general aviation.

Such technologies as the satellite-based Global Positioning System, used for precise navigation, and the Inmarsat satellite communications system, are available even to private citizens worldwide. With these technologies and others, distributed air traffic management can replace the current overloaded air traffic control system.

Prompt action is required to update the air traffic control system with existing technology to match today's traffic loads and the even greater loads expected in the near future. Accordingly, IEEE-USA supports:

- Accelerating use of the existing GPS system, initially for en route and nonprecision-instrument approach phases of flight, to be followed by its uses for precision-instrument approaches and landing through implementation of Local Differential GPS (LDGPS). This is consistent with recommendations of the Future Air Navigation System committee of the International Civil Aviation Organization.

- Adopting a digital data link for two-way communications between aircraft and ground controllers allowing the exchange of position information, weather, and other data.

- Adding a low-cost data link to airport surface vehicles to provide status for these vehicles as well as for aircraft-to-airport ground surveillance systems using LDGPS.

- Encouraging development of standards and certification processes for the Aeronautical Telecommunications Network by the Federal Aviation Administration and a consortium of airlines, to provide commercial products that can be introduced rapidly after demonstration and certification.

- Upgrading the ground air traffic control centers, particularly their computer equipment and automation software to permit taking advantage of the new capabilities available for air traffic management, such as GPS-based direct routes, automatic dependent surveillance (ADS), and digital data communications.

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- Encouraging the development, test and implementation of an air-to-air collision-avoidance system based on mutual one-way broadcast, via data link, of accurate on-board derived aircraft position and velocity information, which has been termed ADS-B.

- Accelerating active cooperation between the Department of Transportation (DOT) and the Department of Defense (DOD) toward the development of a full-capability GPS Wide Area Augmentation System (WAAS) which will provide: (1) a signaling system to alert users when a GPS satellite fails, (2) ranging signals from geostationary satellites to increase the number of signals available for navigation, and (3) differential GPS (DGPS) correction data to enhance the accuracy available from GPS for U.S. Civil users.

- Establishing an open system architecture to encourage the development and offering of commercial off-the-shelf technologies that can be used in the United States, and ultimately used worldwide when appropriate agreements are reached.

Madam Chairwoman, we appreciate the opportunity to present the committee with this statement and would be pleased to work with you and your staff on this issue in the future. Thank you.

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